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HOME CANNING OF FRUITS AND VEGETABLES

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SUCCESS in home canning depends a good deal on how well the canner understands the "why" of each step in the method. For that reason and because of an increasing interest in and demand for such information, this bulletin goes more thoroughly into the science of canning than would ordinarily be justified in a popular discussion of how to can. The reader who wishes to turn at once to directions for canning will find them beginning on page 14.

This bulletin is intended to replace Farmers' Bulletin 839, "Home Canning by the One-Period Cold-Pack Method," and 853, "Home Canning of Fruits and Vegetables," as far as the home canning of fruits and vegetables is concerned.

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HOME CANNING OF FRUITS AND VEGETABLES.

Prepared by the Office of Home Economics, States Relations Service.

WHY CAN?

(1) To make ourselves healthier and better nourished; (2) to provide a pleasing variety of succulent, tender young fruits and vegetables throughout the winter instead of having them only during the few days or weeks when they are in full season; and (3) to save food which otherwise would go to waste.

The chief fault to be found with many American dietaries is that they contain too large a proportion of manufactured foods, such as white flour and cornstarch and polished rice; of sugar and lard and oils, and of pies, cakes, candies, and sweets made from these things. Canned fruits and vegetables will help to supply us more fully with organic acids, with mineral matter in various forms; and (to a certain extent) with those newly discovered substances called vitamins. Mineral salts and vitamins of several kinds are essential for growth, health, and well-being, and may sometimes be procured to better advantage from fruits and vegetables than from more expensive foods. It has frequently been urged that the heat of canning destroys vitamins. Recent investigations, however, indicate that this is by no means invariably true, or if it occurs may be only partial; and if, for instance, 2 tablespoonfuls a day of the juice of canned tomatoes will prevent an infant from having scurvy—as seems indeed to be the case—it is not necessary to concern ourselves with the problem of whether one-half tablespoonful of the juice of fresh tomatoes might not have done the same work just as well. So far as is known at present the value of canned fruits and vegetables as sources of much needed "mineral salts," organic acids, and certain other valuable food materials is approximately equal to that of the freshly cooked fruits and vegetables.

Canning is one of the most desirable means of preserving fruits and vegetables; for it preserves these foods in a condition more nearly like that of the freshly cooked product than is the case with dried, brined, or pickled fruits or vegetables. There is also the further advantage that when the canning is done the product in the can is practically ready to serve.

Canned products are worthy of a larger share of the housewife's consideration than they usually receive. They are, indeed, a valuable resource in time of emergency; yet they may also be used as foundation for a great variety of delectable dishes. There is a great differ-

ence between canned tomatoes simply heated as they come from the can and the dish of scalloped tomatoes which may be prepared from the same can, the contents of which have had their natural flavor judiciously enhanced by the addition of such seasonings as buttered crumbs or savory rice, green peppers, a few drops of onion juice, a bit of bay leaf, a spoonful of sugar, or a piece of mild cheese. The same principle applies to other canned products, most of which may be used in as many different dishes as may fresh fruits and vegetables.

CAUSES OF SPOILAGE.

The art of canning was discovered more than a hundred years ago by a Frenchman named Appert. About 70 years later another Frenchman, Pasteur, proved that foods spoil because of the growth of very small plants, or microorganisms, of various kinds, such as yeasts, molds, and bacteria. These small organisms are looked upon as plants rather than animals, although they are not like any of the green plants with which we are so familiar. They not only consume our food, but they also defile it by producing various substances which spoil its flavor and appearance. In some instances they produce substances which cause illness or even death.

The appearance of molds is familiar to us all, because they usually grow on the surface, at least when they form their fruits or spores. These black, or white, or variously colored spores are formed in such abundance that their fuzzy mass is very plainly visible to the naked eye. They grow readily in, and on the surface of, such materials as bread, fruits, vegetables, jelly, cheese, sour milk, and even leather and cloth, in the form of "mildew." Their spores or "seeds" are blown about in the air, and are always ready to grow on the surface of jelly, preserves, and many other foods which have been left exposed. Molds, however, do not give much trouble in canning by modern methods.

Household yeasts are also more or less familiar to most of us, because one of the wild yeasts has been "tamed" or domesticated and is used, either in the form of "yeast cakes" or in some liquid form, for the making of bread. This same yeast is also useful in starting the process of vinegar making. There are many kinds of yeasts. When any kind of yeast grows in jelly, preserves, or canned products, its presence is highly objectionable because the fermentation which it brings about destroys the attractiveness and wholesomeness of such foods, so far as ordinary table uses are concerned. However, yeasts (like molds) are usually killed by heating for a short time, and therefore give comparatively little trouble in canning.

The destruction of bacteria is an altogether different matter. These organisms are very much smaller than are yeasts and molds

and are much more likely to cause trouble in canning. Bacteria are so small that it would take more than 10,000 of them of average length, placed end to end, to measure 1 inch.

There are always microorganisms of one kind or another present on the skin or rind of fruits and vegetables. Bacteria, yeasts, and molds are found to a greater or less extent in the air, in natural waters, on our own skin as on all animal bodies, in the soil, and in dust. If we are canning food which we expect to keep perfectly for a period of weeks, months, or even years, we must make every effort to see that we do not allow any bacteria, yeasts, or molds to remain in the jar or can to grow on the food in the sealed container and spoil it. All utensils and materials must be kept as clean as possible and must be carefully handled to prevent the entrance of dirt and bacteria or other organisms, so that the chances of spoilage will be greatly lessened. Bacteria multiply with astonishing rapidity, especially in a warm, moist place. Many bacteria, yeasts, and molds can not grow except in the presence of air or oxygen, but there are many varieties of bacteria which grow very well indeed in the sealed can or jar, after all the air or oxygen it is possible to take out has been removed.

WHAT IS STERILIZATION?

Since many very common kinds of bacteria can live without air, it is desirable to apply sufficient heat to foods which are sealed away from the air to kill all such bacteria; or at least, all of those which can grow in the canned food material. When we succeed in killing *all* bacteria present in a given space or on a given article we say that we have sterilized it; just as the surgeon sterilizes his gown and instruments by boiling or steaming or baking them for a long time or at a very high temperature, or by the use of certain chemicals. Absolute sterilization is, however, difficult to attain, because of the unfortunate circumstance that many bacteria can form very minute and highly resistant bodies called *spores*. These spores are capable of surviving for long periods of time in spite of unfavorable conditions.

The bacterial spores are so well protected that they can endure extreme temperatures for considerable periods. The spores of some bacteria have been found to resist the temperature of boiling water for 38 hours. Of course no one would think of cooking young, tender vegetables for that length of time. Fortunately, most of the spores commonly found on fruits and vegetables appear to have much less resistance to heat.

PROCESSING VERSUS STERILIZATION.

Processing as a canning term means the application of heat to food materials in such a way as to insure preservation and secure the

maximum of good quality. It usually refers to the application of heat to the sealed or partially sealed container, as when jars of fruit or vegetables are heated in boiling water or in steam. It may or may not result in sterilization, but must result in the production of an attractive and wholesome article of food and insure preservation. The heating process should be as short as it is possible to make it and yet be sure of attaining the desired result. Fortunately, some of the very resistant spores occasionally found on certain vegetables belong to that class of bacteria which can not grow except when freely supplied with air; so they do not always get a chance to develop in the canned vegetable.

In the case of canned fruit and tomatoes the presence of acid makes a short application or a mild degree of heat much more effective in destroying bacteria and their spores than would be the case if the acid were lacking. Furthermore, there are many bacteria which can not grow well in the presence of acid, not even in so mild an acid as a fruit contains; nor in heavy sugar solutions. These circumstances make it possible to use a much shorter heating process with fruits than with vegetables, most of which contain comparatively little acid.

It is well to recognize the fact, then, that canned goods will not always be absolutely sterile, even though perfectly sound and fit for consumption. This is true of commercially canned as well as of home-canned goods. The surviving spores, however, being few in number can do no harm, provided they remain dormant, i. e., without growth of any kind, even though they may be capable of germination for many months or even years after the processing period.

To summarize the more important considerations deduced from the bacteriology of canning:

(1) It is wise (if not absolutely necessary) to attain and preserve some degree of vacuum within the can or jar, i. e., there should be less air pressure inside the jar than outside it, and the cover should be difficult to loosen because of the extra pressure on the outside of it; or in case of the tin can, the ends should be somewhat drawn in when cool. This partial vacuum is the result of the jar or can being sealed while its contents are almost at the boiling point, or at least very hot; the contraction of air and condensation of steam in cooling are the cause of a lowered pressure within the sealed space.

(2) Sufficient heat should be applied to destroy those bacteria which can grow in absence of air, or at least those which would find favorable opportunity for growth in the canned food, under the conditions of storage which it must withstand. This degree of heat is likely also to destroy many, but perhaps not all, the spores of "air-loving" bacteria.

WHY IT IS BETTER TO PROCESS AFTER PACKING IN THE CONTAINER.

From what has already been said, it is easy to perceive that scalding and boiling the jars, covers, and rubbers to be used in canning may help greatly by killing a large number of the bacteria present, yet it must not be expected that all the bacteria will be so easily killed, or that the containers can be actually sterile after a few minutes of scalding or even boiling. Even if the containers are boiled long enough to destroy all organisms present, it would be a mistake to suppose that these articles will remain absolutely sterile after being removed from the hot water. The fingers which handle them, of course, are not sterile; they are perhaps laid down on a table which is not sterile, and they are certainly left for some seconds or minutes exposed to air which is not sterile.

In the old-fashioned open-kettle method of canning the food was cooked in the kettle or pan and then the scalded can or jar was filled with this boiling hot product and sealed without any processing or cooking in the container. However, the considerations just mentioned constitute one of the reasons why the "open-kettle" method of canning usually fails when applied to any food material which is at all difficult to keep, such as most vegetables, meats, and milk. The food material and the jar and cover are open to bacteria in the air during cooking and filling of the jar. On the other hand, fruits and tomatoes may often keep well when canned in this way. This is because of the acidity of their contents, which (as has already been mentioned) causes the destruction of bacteria during the heating process to be more rapid than would otherwise be the case. However, the practice of packing the fruit or vegetable into the container before rather than after applying the final heating process is more likely to succeed in the destruction of organisms. It is, as a rule, important that the greater part of the heating process should be done *after* the can or jar is filled and closed away from further sources of contamination.

WHY FRUITS AND VEGETABLES SHOULD BE CANNED ONLY WHEN ABSOLUTELY FRESH AND SOUND.

Many of the bacteria which form heat-resistant spores are found in the soil, and thus are quite likely to occur upon the surface of fruits and vegetables. If these products stand for some days or even hours after being picked, certain bacteria will have a chance to multiply, which they did not have while the fruits or vegetables were growing in the field, garden, or orchard. When packed or piled together, the vegetable or fruit mass may very likely heat in the center, even if stored in a comparatively cool place. Thus these

bacteria will be supplied with all the conditions that most favor their rapid development—warmth, moisture, darkness, and an abundant food supply. The result is rapid growth and development of several new crops of bacteria. Evidently, then, our chances of success in the effort to kill all the bacteria and their spores will be very poor, compared with what they might have been if the perfectly fresh vegetables or fruit had been promptly canned.

For similar reasons, no fruit or vegetable which is unduly soft, overripe, partly moldy or decayed, or withered, or bruised, should be canned. Most of these conditions mean that there is already present an unusually large number of microorganisms of some kind, which have caused or aggravated the blemish. In case of bruising or oversoftness, the injured or dying plant tissues have a very low resistance to bacterial attacks, consequently bacteria grow much more rapidly in them than would otherwise be possible.

There is another reason why speed is imperative when handling these perishable products. There are present in all plant as well as animal tissues certain substances called enzymes which have power to produce very great changes in the character of the tissues, independently of the changes wrought by the growth of bacteria. The apple, as it ripens, becomes less starchy and more sweet, because its sugar-forming enzymes transform the starch into sugar; at the same time, other enzymes cause the disappearance of the acids of the green apple. As ripening progresses still further, another set of enzymes brings about the softening of the cell walls which results in mealiness, and still another set causes the gradual disappearance of the sugar, so that the "dead-ripe" apple is no longer as sweet as it was. Equally important changes of one sort or another take place in all fruits and vegetables during ripening.

In some actively growing products, such as young green peas, asparagus, and sweet corn, these enzymes work with exceeding rapidity, and sweetness is lost with each succeeding hour that passes after they are gathered.

"One Hour from the Field to the Can" is an excellent slogan for home canners, especially when canning that most difficult of all products, corn. Its adoption as a working guide would do much to improve the quality and insure the safe-keeping of canned products.

FERMENTATION AND "FLAT SOUR."

Very often spoilage is accompanied by the evolution of much gas, which is plainly visible through the glass jar, or which, if it occurs in tin, causes the ends of the can to bulge, making a "swell." In other cases, however, there is no gas formed and the product may appear to be in good condition as far as the inspection of the closed container is concerned; yet, upon opening, it may be found

that the flavor is unduly sour, or disagreeable in some other way, so that the product can not be used at all. The term "flat sour" has been used in connection with those types of spoilage in which there is formation of acid without gas or bubbles. It is impossible in many cases to be sure that canning has been really successful without opening the jar or can.

HOW TO TELL WHEN CANNED FOOD IS SAFE TO EAT.

It is the opinion of most bacteriologists that we have not much occasion to dread food poisoning from canned food, provided we make it a rule to look at and smell carefully every can of food when it is first opened. The canning factory maintains a rigid inspection; why not introduce an equally good inspection service into your own home? Begin by inspecting the container before it is opened. If it is a glass jar look for gas bubbles and note whether the product seems to have changed color or become mushy. The lid should require the application of some force to remove it, for the sealing of the jar while its contents are boiling hot results in the formation of a partial vacuum, and if the seal remains perfect the pressure of the surrounding atmosphere holds the lid down. Similarly the tin can should be flat or slightly drawn in at the ends when cool. If swelled or bulged the probabilities are that the contents have spoiled as a result of the action of gas-forming organisms. It is a safe rule to discard, without tasting, any canned food which has conspicuously softened or has become mushy to an extent not warranted by the cooking process to which it was subjected; or which contains gas bubbles; or which has a peculiar or unusual smell. If the canned food successfully passes all of these tests but is found to possess an unduly sour taste, or an unusual flavor of any kind, it should at once be rejected; and the portion tasted should also be rejected without swallowing, to prevent any possible danger of poisoning.

It is a fortunate fact that spores are not as a rule found in those disease-bearing bacteria which are at all likely to occur in canned products, so far as we know at present. The exceptions to this statement are so rare that they should not properly be used as an argument against either commercial or home canning. One hears a great deal about *Bacillus botulinus* poisoning from canned and bottled goods; the danger is a real one in some localities, yet the actual number of outbreaks of botulism *at the present date* is exceedingly small in comparison with the number of people who consume canned goods. Furthermore, botulinus experts among the bacteriologists state that botulism from canned products can be guarded against by use of four simple expedients, which are as follows:

(1) Make it the absolutely invariable rule never to can any vegetable or fruit not in first-class condition; that is, *do not* can food

which is slightly moldy or specked, oversoft, or "just ready to spoil," or partly rotted. Cutting out the soft spots and using the rest for canning may prove very poor economy in the end.

(2) Give all canned food a careful and rigid inspection *at the time the can or jar is opened*, and discard any material having an unusual appearance or odor, *without even tasting it.* It is a useful precaution to notice the odor of the vegetable while it is boiling, since heat often intensifies certain putrefactive odors.

(3) *Boil the food as it comes from the can before tasting it.* The spores of *Bacillus botulinus* may withstand long boiling, but fortunately are not likely to grow in the human body. Their poison, however, is destroyed by thorough boiling; certain authorities recommend that the boiling process be continued for 30 to 45 minutes. It must be clearly understood, however, that we can not safely consume spoiled food even after boiling.

(4) The final disposal of canned goods which have spoiled, or are suspected of spoilage, is a matter of real importance. Chickens and other animals may be and often have been fatally poisoned by eating such spoiled materials. Even worse than this danger is the possibility of spreading the *Bacillus botulinus* (possibly other dangerous spores) through the soil. With such considerations in mind it would seem that spoiled canned goods should be treated as we should treat any sort of infectious material, such as the discharges from a typhoid or tubercular patient or the carcass of an animal which has died of anthrax; that is to say, they should be burned, or, if that is impracticable, they should be boiled for an hour with some efficient disinfectant in order to be sure that all dangerous spores are destroyed. Burying them *deeply* in the soil with a generous covering of quicklime will prevent the poisoning of domestic animals and may have some influence in preventing infection of the soil with a highly dangerous organism.

DIFFERENT WAYS OF PROCESSING.

The vegetable or fruit may be processed, or cooked inside the can or jar, in any one of three different ways:

(1) Heating the sealed can (or partially sealed jar) under steam pressure by the use of canners made specially for that purpose. The temperature of the steam will be above the boiling point of water; it varies according to the amount of pressure used. Temperatures usually employed in canning lie between that at which water boils (see table, p. 48) and 250° F., which corresponds to a pressure of 15 pounds of steam. (See Table 5, p. 48.) Higher temperatures than these might be used if it were not for the danger of overcooking.

(2) Heating the can or jar in a water bath (e. g., in a wash boiler) or steam bath (e. g., in one of the "cabinet" steamers which has a false bottom and closes with a "front door"). The bath of water or steam is kept boiling hot continuously for a length of time required to secure satisfactory results with the fruit or vegetable. This is the "one-period" or "continuous" process.

When heating the can or jar in an ordinary household steamer, the temperature of the steam should be maintained at the boiling point of water. This temperature can be maintained only if the cover of the steamer is tight, if the steamer fits very closely over the kettle which supplies it with steam, if a vigorous flow of steam is kept going into the steamer, and if the steamer be not too closely packed with jars of material to be processed. If any one of these conditions fail, the temperature inside the steamer may be from 10° to 20° below the boiling point; this is often the case with household steamers. *Do not try to can in a steamer* unless it has a tightly fitting flanged cover, or some device at least equally efficient. *Always use a thermometer when canning in a steamer, and count the time from the moment that the temperature reaches 212° F.*, or the boiling point.

(3) Heating the can or jar in a water bath (or household steamer) for two, three, or more periods, with intervals between the periods of from 6 to 24 hours, depending on the climatic conditions and products canned. This is known as the fractional or intermittent or three-period process. The temperature of the water or of the steam is, of course, to be maintained at the boiling point of water.

As will be seen from Table 5, the use of steam pressure enables one to maintain a temperature much higher than 212° F. and is the most effective method in case there are resistant spores to be killed; for by means of its use the vegetable mass may be cooked in steam which is at a temperature as high as 250° F., or even higher if necessary.

It must be remembered that the rate of penetration of heat into the center of the vegetable mass varies greatly for different vegetables. The temperature of the liquid in the center of peas packed into a quart glass jar set into boiling water may reach the temperature of the water bath in 20 minutes, whereas tightly packed spinach under the same conditions may require 1 hour and 20 minutes, and sweet corn packed Maine style (that is, of semisolid consistency) may require almost 2 hours and 20 minutes to reach the boiling point at the center of the jar, unless packed very hot. The time required for the attainment of a given temperature within the container would, of course, be shorter when using high processing temperatures by means of steam pressure; it would also be somewhat shorter when tin containers are used instead of glass, at least when freely circulating liquid is present in the can or jar.

The more tightly packed the vegetable or fruit mass is and the less water it contains, the longer it will take for the heat to penetrate through it.[1] One of the reasons why corn requires so long a time for sterilization, even at high temperatures in a steam-pressure canner, is this fact that it heats through very slowly. This slowness of heating is still more marked in a wash boiler or other water bath, where the water of course is not above 212° F. Steam-pressure processing is decidedly preferable in canning this and other products which prove especially difficult to can; for as the temperature of the steam in the canner is raised, the rate of penetration of heat into the container is markedly quickened, other things being equal. Moreover, the resistance of spores decreases very rapidly as the temperature of their immediate surroundings rises above the boiling point of water, consequently the rate of destruction of spores is often several times as rapid at 15, 10, or even 5 pounds of pressure as at the boiling point of water.

Particularly is the steam-pressure method preferable in case there is no cool place in which to store canned vegetables. Repeated experiments have shown that canned vegetables which have been processed 1, 2, 3, or more hours in the water bath may keep sound and in very good condition provided the temperature of the storage room does not often exceed 60° F., whereas jars or cans taken from the same lot of canned vegetables and kept in a room whose temperature ranges from 65 to 80° F. throughout the daylight hours may show high percentages of spoilage. Similarly it has been shown that spoilage increases still more rapidly when the storage room temperature rises to a range of 80 to 100° F. throughout the whole 24 hours and when vegetables containing certain types of resistant spores are processed at temperatures not higher than that of the water bath.

It is therefore not surprising that those who practice canning in the more trying climates, and where cool storage places are not available, have strongly advocated more vigorous processing measures than other operators find it necessary to enforce.

Steam pressure should be used, whenever a canning outfit of this type can be had, for corn, beans, asparagus, okra, spinach and other greens, and peas (especially if at all mature).

When processing acid products, such as fruits and tomatoes, which are comparatively easy to can, steam pressure may not be

[1] When the convection currents of heated liquid, which travel so readily from bottom to top through a body of water, are interrupted by solids, the rate of heat penetration is often markedly slowed. In processing each vegetable, then, one should add the length of time required for heat penetration (if known) to the length of time required for sterilization after the mass has reached the required temperature. Unfortunately such data are lacking in the case of most vegetables and fruits. The figures given in Table 3, page 47, for length of time of process, however, represent the experience of successful canners in various parts of the country.

necessary, and the water bath method is often employed because of the more excellent flavor, texture, and appearance secured by its use for canning these products. Indeed, processing temperatures below the boiling point are often successfully used for certain acid fruits.

The household steamer is not so generally used for processing canned products as is the water bath, chiefly perhaps because of the greater convenience of the latter method, especially when a considerable amount of canning is to be done. However, it is very conveniently used for a few jars of fruit, tomatoes, or even of root vegetables, which happen to fit easily into the steamer. It would be a mistake to pack a small steamer tightly with jars so that there is little space for the circulation of steam, for then the jars heat very slowly, because of their great cooling effect upon the circulating steam when they are first put into the steamer. By the use of a thermometer one may know whether the temperature inside the steamer is really at boiling point or not.

The one-period process is used for several purposes. For example, it is widely employed in the home canning of fruits and tomatoes. In the cases just mentioned, this method is for the most part successful, for the combination of plant acids and heat usually either kills all the microorganisms present or else kills most of them and hinders the remainder from growing. In those climates where storage conditions are not especially trying, this method is often successfully used for the canning of vegetables. Whenever it is found to be unsuited to any given locality or product, the steam-pressure method should be substituted if possible.

The use of the intermittent or three-period or fractional process is based upon the theory that a short period in boiling water (say of 1 or 1½ hours) should suffice to destroy all bacteria in the vegetative form. By cooling the vegetable mass rapidly to room temperature and allowing it to stand for 6 to 24 hours, opportunity is given for surviving spores to "sprout" or grow into the vegetative form; after which the second processing period will kill all of the young, tender cells which have just germinated from the spores. The third processing period is added in order to catch newly germinated cells from any spores which may have failed to germinate within the first intermission. Processing in this manner is often successfully used with vegetables which are difficult to can.

There are at least two contingencies which may sometimes interfere with its successful operation, especially in the hands of inexperienced canners and when the old rule "one hour on each of three successive days" is too strictly adhered to. In the case of those vegetables which pack very solidly in the can, such as spinach or corn, the

heat penetrates so slowly that it may take an hour and a half for the material in the center of a glass quart jar to reach the boiling temperature, especially if packed after cold dipping without reheating. Of course the contents of the sealed jar are always cold at the beginning of the second and third heating periods (although the operator does not begin to count the processing period until the water bath reaches the boiling point). Consequently in such cases the bacteria present are not subjected to boiling temperature at all, since the center of the mass may never reach the boiling point if heat is applied for one hour only during each processing period. To meet this difficulty, instructions are often given to use only the smaller sizes of glass jars or tin cans for processing corn and some other vegetables in those situations where experience teaches that difficulties are to be anticipated. Also the length of each processing period is increased from 1 hour to 1½ hours in some instances.

In some cases the vitality of some of the most resistant spores appears to remain practically unimpaired by the first heating process. In very warm weather such surviving spores may germinate so rapidly that the young bacteria formed from them are able to form a second crop of spores within 24 hours. In such case the second processing period has no greater chance of killing all organisms than had the first one; it has, indeed, much less chance. It is for this reason that the suggestion has been made to decrease the interval between processing periods from 24 hours to 12 or 18 hours.

In all cases it should be remembered that for most vegetables the steam-pressure canner, if available, furnishes a means of processing which is preferable to any known method of processing in the water bath or in steam at 212° F., at least so far as the prevention of spoilage is concerned. However, it is necessary to use a sufficient process with this as with any other canner. Highly resistant spores occurring in a nonacid product which heats slowly (such as corn) may die hard, even at 5 or 10 pounds steam pressure.

Canning is not an exact art any more than is cooking in general, since it is impossible to predict with certainty the nature of the bacteria which may be encountered or their degree of heat resistance. We must therefore expect variations in practice among successful canners. Good judgment, great carefulness, and adaptation to individual and local requirements are necessary to the best results in this useful household task.

EQUIPMENT FOR CANNING.

Whatever type of apparatus is used for processing, a number of utensils, which are ordinarily found in every home, are necessary for the proper handling of the products.

UTENSILS FOR PREPARING FRUITS OR VEGETABLES.

For grading, sorting, and washing, shallow trays, pans, or bowls, and vegetable brushes are needed. For washing berries and for draining, a colander or sieve may be used. Several squares of cheesecloth, or wire baskets, may be used for holding the fruits or vegetables during the blanching process. Some container, such as a large enameled bucket, galvanized lard can, or wash boiler, which will hold enough water to submerge a convenient quantity of the product to be blanched, should be provided. Several kettles will be needed for blanching, for rinsing after blanching, etc. A teakettle should be kept full of boiling water, as a fresh supply will be needed from time to time for filling jars and for renewing the blanching water. Slender-pointed, sharp paring knives are convenient for peeling and cutting. It is well to use a silver knife for peeling some fruits, as the fruit is sometimes discolored by steel. Tablespoons, teaspoons, measuring cups, and spatulas should be at hand. Trays provided with handles will be needed for holding the jars while in the boiler and for lifting them into and out of the boiling water, or a false bottom may be provided for the boiler. (See paragraph on water-bath canner, below.) In this case some sort of a jar lifter will be needed. Many kinds of patent holders or lifters may be purchased, or a lifter may be improvised—e. g., a large buttonhook works well with those jars which have a spring clamp over the top.

When canning in large quantities, such conveniences as slicers, corers, pitters, apple parers, food choppers, scales, and saccharometer, will make it possible for the work to progress more rapidly.

If the product to be packed is to be cooked first, then spoons, sieves, and saucepans are necessary. Funnels and packing spoons or flexible metal spatulas or wooden paddles will aid in filling the jars and in removing air bubbles.

If the canning is to be done out of doors, tables of convenient height, a covered garbage pail, and flytraps are needed. A kerosene stove (fig. 1) is convenient for heating water, etc.

TYPES OF CANNERS.

Water-bath canner.—The simplest hot-water outfit is one to be placed on the kitchen stove. It consists of any vessel large enough to hold a convenient number of jars, fitted with a false bottom which holds the jars away from the bottom of the utensil, thus protecting the jars from bumping and overheating, and allowing full circulation of water under them. Several convenient canners of this type are on the market. A large bucket, a wash boiler, or a small metal wash-tub which can be covered tightly will serve for this purpose. The false bottom may be made of wooden strips or of strong wire netting,

which is raised an inch or so above the bottom of the vessel. Do not attempt to use newspaper, hay, straw, or cloth in place of the false bottom, since materials of this sort pack closely against the bottom of the container and will not allow the water to circulate freely beneath the jars or cans.

Another and more complete canner is one constructed especially for outdoor work (fig. 2). It has a fire box, smoke pipe, and vat for processing, which are combined in one piece; and with it are supplied lifting and blanching trays, tongs for handling hot jars or cans, and tools necessary for sealing tin cans. Canners of this type are light and convenient and are planned as portable outfits. Their one ad-

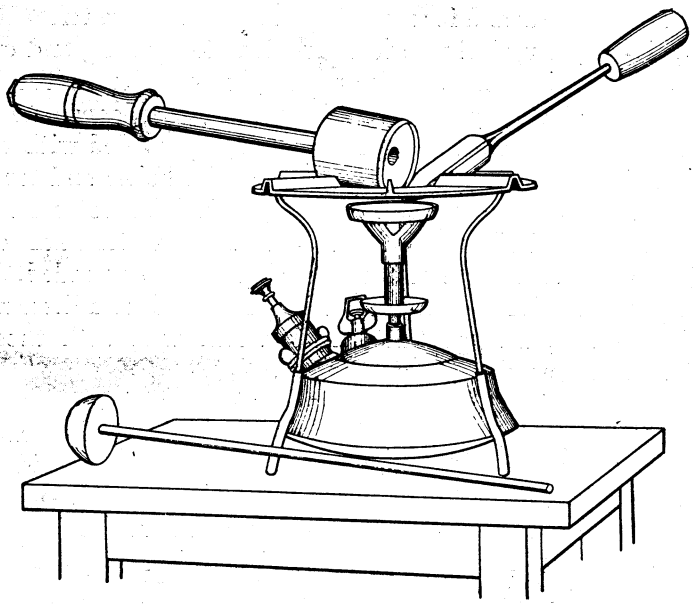

FIG. 1.—Kerosene gas stove.

vantage over the homemade device is that they are more convenient and have all the necessary equipment for operation.

The canner should be chosen with reference to the kind and amount of canning to be done. The small water-bath canner (such as the wash boiler with false bottom) is the least expensive of the outfits for home canning. For inexperienced people it is also more easily handled.

The water-bath canner is always preferable for processing fruits and tomatoes, except at high altitudes (see p. 48); and on account of the acid they contain these are easily canned at the temperature of boiling water.

Water-seal canners.—Water-seal canners consist of a double-walled bath and a cover which extends down into the water between the outer and inner walls, thus making three tin or galvanized metal walls and two water jackets between the processing vat and the

outer surface of the canner (fig. 3). A temperature somewhat higher (perhaps 2° or 3° F.) than the boiling point may thus be maintained inside the canner, as a result of the slight pressure secured.

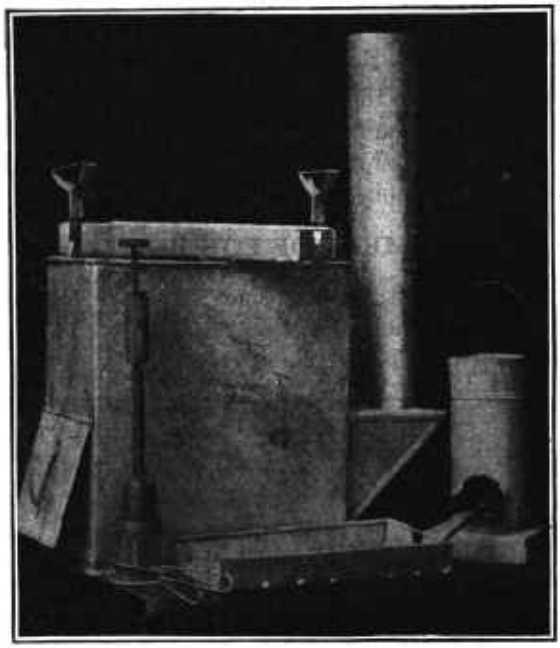

FIG. 2.—A small portable hot-water canner and fixtures specially adapted for out-door work.

The advantage claimed for this type of canner is that only a small quantity of water is needed and it can be raised quickly to the boiling point with the use of very little fuel. It may prove quite economical of heat, especially in the canning of those vegetables for which a long processing period is necessary for successful results. However, a thermometer should be used and time should be counted only when the boiling temperature is attained in the inner chamber

Steam-pressure outfits.—The steam-pressure canner (figs. 4 and 5) is constructed of strong material and provided with a tightly fitting lid, which when clamped in place makes it possible to hold steam under pressure and obtain a correspondingly high temperature. (See Table 5, page 48.) Most steam-pressure outfits will carry up to 30 pounds pressure with a corresponding range in temperature from 212° to 274° F. Each steam-pressure outfit is equipped with a pressure gauge, which registers the pressure in pounds and the corresponding

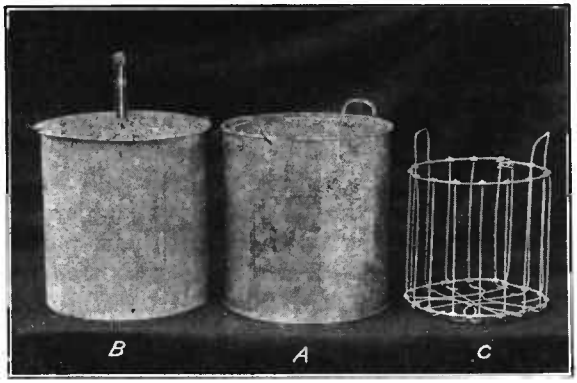

FIG. 3.—A type of water-seal canner: (*A*) Double-walled vat; (*B*) cover with thermometer; (*C*) crate for jars and cans.

temperature; with a safety valve, steam petcock, and lifting crate. The pressure canner may be easily regulated so as to maintain the desired pressure and temperature. It is thus suitable for use in processing various vegetables and other food products which are difficult to can. It is also especially adapted for use in high altitudes, where the temperature of boiling water is much below 212° F.

Pressure canners range in size from the very small one which will contain only three quart jars to the factory sizes which have a capacity of several thousand cans per day.

ARRANGEMENT OF EQUIPMENT FOR OUTDOOR CANNING.

Discomfort and fatigue can be lessened greatly by carefully arranging the equipment used in canning. When working indoors it is often possible to carry on much of the preparation of the fruits and vegetables on a porch, thus minimizing the work of clearing away refuse afterwards.

FIG. 4.—A type of cast-iron steam-pressure canner. Will carry 30 pounds of pressure.

Canning is more likely to prove attractive work when it is done in a cool, shady, outdoor place, convenient to the water supply and free from dust and insects. This is especially true when several members of the family or a group of club members are working together.

It is well to have two large work tables, of convenient height, in order that different stages of the work may be kept distinct. On one table, for instance, may be placed vessels for sorting and grading, a supply of fresh cold water of unquestionable purity for washing the fruit, and the apparatus for blanching and for heating sirups. On a second table place paring knives, spoons, measuring cups, scales, spatulas or paddles, seasonings, tea towels, etc. Use this table for peeling and packing and place the garbage can near it. When jars have been washed and boiled they may be brought in trays to this table, inverted on a clean towel, and covered until needed. Better still, they may stand in the scalding water and be taken out as they are used.

The canner should be placed so as to be convenient to both tables and should be provided with stovepipe high enough to convey the smoke well above the heads of the workers.

OPERATION OF CANNING OUTFITS.

WATER-BATH.

Difficulties in the operation of water-bath canners may be avoided if the following rules are observed:

(1) Support the cans or jars on a perforated platform or rack which permits the circulation of water under and around them.

(2) Place each can or jar in hot water in the canner as soon as packed, in order that it may be kept as hot as possible. Hot glass jars which have just been filled with boiling water or sirup will not crack if lowered immediately into water which is boiling hot or nearly so. In the case of intermittent processing however, the jars are cold at the beginning of the second and third periods, and these jars should

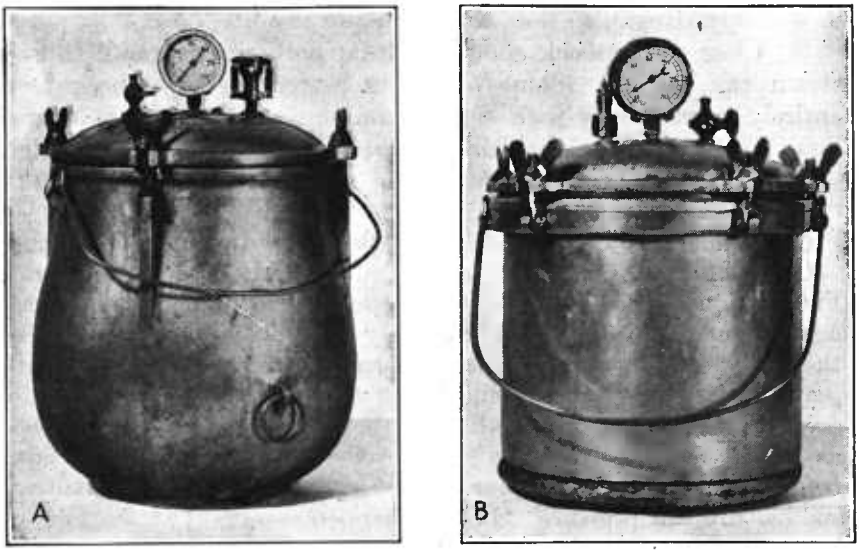

FIG. 5.—Two forms of aluminum pressure canner or cooker.

enter a water bath which is "scalding hot" (140° to 175° F.) but not boiling nor hot enough to crack the jars.

(3) Count time as soon as the water begins to boil vigorously.

(4) Remove the cans or jars from the water as soon as the time is up and tighten the covers.

STEAM-PRESSURE CANNER.

To secure the best results in the steam-pressure canner, the following directions should be observed:

(1) Fill the canner with water to such depth that its level is just below the rack which holds the jars; if heated for some time before closing the canner, add hot water occasionally to prevent its boiling dry.

(2) When packing highly perishable vegetables, such as peas and sweet corn, place each jar in the canner as soon as it has been packed, to keep it as hot as possible. There should of course be heat under the canner and hot water in the bottom; the cover should be kept on though not clamped down. The heat of the circulating steam will thus gradually penetrate the jars and will tend to arrest the growth of bacteria during the period of time necessary to complete the packing.

(3) When the canner has been filled, fasten the pairs of clamps which are placed opposite each other moderately tight, one pair at a time; then go back over the whole set of clamps, tightening each pair fully.

(4) See that no steam escapes anywhere (except at the petcock when it is open).

(5) Allow the petcock to remain open until steam escapes from it in a steady stream, so that no air remains inside.

(6) Close the petcock enough so that only a very small trace of steam can escape. (Some operators prefer to close the petcock entirely, particularly with small aluminum cookers, where a great loss of steam is to be avoided, because of the danger of boiling dry.)

(7) Allow the temperature to rise until the gauge registers the desired steam pressure.

(8) Count time from the moment the desired pressure is reached.

(9) Maintain a uniform pressure during the processing period. Fluctuations in pressure, as from 15 pounds to 10 pounds and back again when canning in glass, are likely to result in loss of liquid from the partly sealed jars. The steam formed under the liquid inside the jar at the pressure of 15 pounds can not upon sudden reduction of pressure escape fast enough through the narrow space between rubber and cover, and it "boils up" so furiously that it pushes the liquid before it and out of the jar. This is likely to happen with any sudden drop in pressure. It may happen especially if the pressure is allowed to go so high that the safety valve releases the steam suddenly.

Uniform pressure may be best maintained by turning the gas or kerosene flame up or down as need arises, or in case of coal or wood stove by moving the canner partially off the hotter portions of the stove and back again.

(10) At the end of the processing period remove the canner from the fire. Then proceed as in paragraph 11 if using tin cans, or as in paragraph 12 if using glass jars.

(11) When canning in tin, open the petcock wide at once and allow the steam to escape rapidly; the cans are completely sealed and there can be no loss of liquid from them. Cool the tins by plunging them into a bath of cold water; this cold bath should be running water if possible, or if not it should be renewed several times. The more rapidly the product is cooled (to "stop the cook") the less danger of overcooking.

(12) When canning in glass jars which are only partially sealed allow the canner to cool until the steam gauge registers zero before opening the petcock. (This is to prevent too sudden a drop in pressure, which would cause the liquid to blow out of the jars.) Indeed, it is sometimes necessary to wait three or four minutes after the zero point has been reached before opening the petcock. The length of this necessary pause can not be definitely stated, because it varies somewhat with different canners, different pressures used, and different ways of packing the canner with jars; this is a detail which must be learned by experience. This pause before opening the canner must not be too prolonged, because the formation of a vacuum (due to condensation of steam) will begin after the pressure inside the canner has fallen to the ordinary atmospheric pressure; and as this vacuum forms rather rapidly in the space around the jars when condensation has once begun, the suddenly released pressure inside the jars causes blowing out of the contents before the canner is opened. Consequently the operator must learn to judge the moment at which the space inside the canner has reached zero pressure; that is to say, atmospheric pressure. As the gauge does not register the first pound or two of pressure, this point will be actually reached a little later than the zero point as indicated by the gauge.

Remove the jars from the canner and tighten the lids, being careful to see that no draft strikes them. Do not stack jars or cans close together until thoroughly cool.

CONTAINERS.

GLASS JARS.

For home use glass jars are more economical than tin, because they can be used repeatedly and with care will last for several years.

Rubber rings must be new each season. It does not pay to use them a second time, since the spoilage frequently resulting much more than offsets the cost of new rubbers. It must be remembered that modern methods of canning constitute a much more severe test for endurance of rubbers than does the "open-kettle" procedure, since the rubber now has to withstand moist heat for a number of hours in canning some garden products.

The rubber must be of good quality. Test the rubbers by inserting forefingers and stretching the ring; if the rubber cracks, or if it does not readily return to its former size and shape, it should not be used.

The following tests may be used to determine the quality of jar rings, in case there are special difficulties in securing a good quality of rubber by the ordinary tests:

(a) *The test for tensile strength.*—Pour into a light-weight pail 1 gallon and 7 pints of water (total weight approximately 17 pounds). Place the jar ring around an empty spool; pass a wire through the

center of the spool and fasten to handle of the pail; then pass the round handle of the wooden spoon or broom through the ring and lift. The ring should not break.

(b) *The test for elongation.*—Cut a 6-inch piece out of a ring; take hold of the ends so that there are 4 inches of rubber between the fingers; stretch the piece along a ruler until the fingers are 10 inches apart. The ring should not break.

There are several types of glass jars which are very common. Among them are the screw-top mason jar and its various modifications, the wire-clamped glass-top jars, and the automatic seal jars.

The original type of mason jar seals with a screw cap usually made of zinc with the top lined with porcelain. This top sometimes becomes loosened and the cap is then difficult to clean and sterilize. Then, too, its edge may be bent in opening the jar, so that thereafter it fails to make close contact with the rubber ring. There are several improved types of the mason jar, among which is one which has a glass top fitting down onto the rubber ring and a metal ring which screws down over the glass top, holding it in place. This jar needs no new parts from year to year except the rubber ring, and it is easily sealed and opened.

In the wire-clamp glass-top jars the cover is a glass disk which fits down onto the rubber ring and is held in place by a wire clamp. This type of lid is very easily cleaned and sterilized, and if handled with care will last as long as the jar. The jar is easily sealed, there is no part (except the rubber) to be renewed each season, and it can be opened with little difficulty.

The automatic seal jar has a lacquered metal top. This consists of a disk, around the edge of whose under surface is a small groove filled with a hard wax-like compound, which, when heated, softens and adheres to the glass. During the processing period the top is held in place by a metal spring or clamp. As the jar cools this compound hardens, sealing the jar. These jars have a wide mouth and are especially good for packing whole fruits of the larger varieties and for those products which require only a short processing period. For products which are to be processed intermittently or for a long continuous period, or with steam under pressure, the wax-like compound may be so affected by the long exposure to heat as to fail to make a perfect seal. These jars require a new lid each time they are used.

There is another type of automatically sealed glass jar which is being used especially by those whose products must be shipped long distances in glass. This jar is made of very heavy glass and is somewhat shorter and broader than the usual glass jar. The opening is approximately of the same diameter as is that of the commoner types of glass jars, and around the top is a heavy projecting rim over which the lid is clamped. The lid consists of a metal

disk lacquered underneath, which fits inside of another metal cover. Around the edge of the inner disk is a groove slightly less than one-fourth inch in width, into which is fitted a gasket of rubber composition three-sixteenths inch in width. The metal cap which fits over this disk comes down over the glass rim at the edge of the jar and by means of a special sealing machine it is crimped around the edge and is thus held securely in position. This outer metal cap prevents the seal from being broken during transportation. The lids must be renewed each season. This jar is especially adapted to steam-pressure canning because it does not permit loss of steam or water during processing, as do most glass jars.

TIN CANS.

For commercial canning and to some extent for home canning, tin cans are commonly used. They are advantageous because there is no danger of breakage, either during the process of canning or afterwards, during storage and transportation. Then, too, the cans may be cooled with cold water immediately after processing, which of course is impossible with glass jars. The larger opening makes it easier to pack most products in the cans than in the jars. At least two types of tin cans are in use at the present time.

The first type, the cap-and-hole can, is much like the old-fashioned wax-sealed cans, but is sealed with solder instead of with wax. The top of the can is provided with a large circular opening which is closed by soldering a tin disk over it. For this purpose it is necessary to have a capping steel. In the center of the disk is a small hole which allows the steam to escape during the exhaust. This hole must be closed by solder before the processing period begins.

The second type of can is known as the sanitary or rim seal can and is rapidly replacing all other types. With the exception of the side seam, no solder is used in its construction. The top is entirely open and is sealed by a double seaming of the cover onto its edge. The part of the cover which comes in contact with the upper edge of the can is coated with a compound or fitted with a rubber composition film or paper ring that makes a perfect seal when the cover is crimped on. The can is sealed with special sealing machines, several types of which are on the market. One of the simpler machines is made adjustable, to handle both No. 2 and No. 3 cans. If desired, it can be furnished to fit other sizes of cans.

In canning most products which are highly acid, and a few others such as pumpkin and squash (which contain certain corrosive substances), it is necessary to use cans which have a lacquered or enameled lining. This inside coating prevents to some extent any action of the fruits or vegetables upon the tin.

PREPARATION FOR CANNING.

Before gathering and preparing the fruits or vegetables, collect all the apparatus to be used and be sure that everything is absolutely clean and in good working condition. Those engaged in the work should observe all principles of cleanliness in the care of clothing, hands, and nails. Do not begin canning in a room immediately after sweeping or dusting. Two or more hours should elapse after sweeping, before beginning the canning. All garbage must be promptly disposed of, for it "breeds germs" as well as flies. When canning out of doors, select a cool, shady spot, well covered with grass and free from dust which might come from the highways or from near-by fields. Flies are great germ carriers and must be kept away from the food being prepared for cans.

The glass jars, of a size appropriate for the fruit or vegetable to be canned, should be tested very carefully for leaks or defects. Fill each jar with hot water, put the rubber and lid in position and seal. Invert the jar and allow it to stand for 5 to 10 minutes. If any leak occurs, examine the jar carefully and if possible determine what is causing the leak. If the jar or lid is defective it must be discarded. If the bail or clasp is too loose, remove it and tighten so that it will hold the lid more closely against the rubber ring and stop the leak. These clamps should be tightened each year.

In case of the old type screw-top jars, be sure that the lid is perfect. Screw it down onto the rubber and invert the jar. If it leaks, and the lid can not be screwed more tightly, try another lid.

If the automatic seal jars are used, examine the top of the jar carefully to see that it is smooth and even. If the rubber composition around the edge of the lid is cut or broken, discard the lid for a new one.

After the jars are washed, place them in a pan of cold water and bring the water slowly to the boiling point. Allow them to boil at least 15 minutes, or until thoroughly scalded. If possible, they should remain standing in this hot water until wanted. They will then be hot and ready for use when the products are ready to be packed.

Special precautions should be observed with those jars which have been emptied of material which has spoiled. Such jars may cause the spoilage of one fill after another, by inoculating each succeeding pack with resistant spores from the preceding one. Even if not used again for canning, it is conceivable that they may inoculate other jars or utensils with these resistant spores, by being washed in the same dishwater or by being handled with them in other ways. Accordingly, they should be sterilized with exceeding care. If a steam-pressure cooker is available they may be packed in it (covers

separated from jars) and given a long process at a high temperature, such as 60 minutes at 15 pounds pressure (250° F.) or 40 minutes at 20 pounds (260° F.). (Since the jars are open and empty and every part of their surface is accessible to steam, it is not of course necessary to allow extra time for the penetration of heat to the center of the jar.) In case steam pressure is not available, jars and covers may be boiled for a short time (10 to 15 minutes) in a very strong solution of washing soda. This solution may be made by dissolving 2 or 3 pounds of washing soda in 1 quart of hot water. (Do not put your hands into this solution.) The jars and tops must be boiled again (or at least thoroughly washed) in clear water to get the soda out of them. Another method of sterilization consists in putting them (after cleaning) into a cold oven and then applying heat so as to bake them, for 2 hours at 400° F. Do not begin to count the time of baking until after the oven has become quite hot. To prevent breakage it is wisest to place the glassware on an asbestos sheet and to refrain from opening the oven door until after the baking process is complete and the oven has cooled.

If tin cans are used, they should be rinsed carefully, or as an extra precaution they may be boiled (except the lids of sanitary cans). When using sanitary cans, the covers of which are fitted with paper gaskets, do not remove paper from cover or permit the gasket to come in contact with water before placing it on the can.

SELECTION OF FRUITS AND VEGETABLES.

Use only fresh, sound vegetables for canning. No products which are withered or unsound should be canned. (See p. 7.) Can all young vegetables and soft fruits the same day they are gathered and as soon after gathering as possible; certainly within 3 or 4 hours.

GRADING AND SORTING.

Sort and grade the fruit or vegetables according to size and degree of maturity. Much depends upon careful grading. If young, tender vegetables are canned in the same jar with older ones, they will be cooked to pieces long before the older ones are thoroughly processed. Overripe fruit may disintegrate, spoiling the appearance of the product and leaving the liquid cloudy. For choice products fruits or vegetables must be in prime condition. Fruits which are underripe, overripe, or decayed in any way, or vegetables which are too mature or which are stale, will not make good products. For this reason discard all fruit that is overripe, underripe, or unsound. Only those vegetables which are in choice condition for the table—that is, young, tender, and fresh—are suitable for canning. Those which are too mature or which have become stale, are more difficult to can, and the product is inferior.

Following the sorting and grading, all products should be washed thoroughly. They are then hulled, pared, scraped, cored, seeded, or sliced, according to the vegetable or fruit to be used, and the purpose for which it is to be canned. Some fruits and vegetables, such as peaches and tomatoes, are very readily peeled if first scalded in boiling water for a short time.

BLANCHING.

Blanching consists of heating the fruit or vegetable in steam or boiling water for a short time, previous to packing and processing (figs. 6 and 7).

It is usually done by placing the product in a wire basket or inclosing it in a square of cheesecloth and plunging in into boiling water for a short time or by steaming it for a somewhat longer time. With either method the length of the blanching period varies with the fruit or vegetable to be canned, and with the age of the product. This preheating shrinks the vegetable or fruit, and makes it more flexible, thus insuring a better and fuller pack. It often helps to cleanse the material and may remove or destroy some of the bacteria which cling to it.

FIG. 6.—Packing the product to be canned in cheesecloth for blanching.

During the blanching process the kettle or steamer should be kept closely covered, and the time is counted from the second the product comes in contact with the heat. Do not wait for the water to begin boiling after the product is immersed, but cover the kettle closely and begin counting the time at once. This is especially important in the case of fruits and tomatoes, for any additional cooking beyond the time set for the blanch tends to overcook them and to destroy both texture and flavor.

At least 4 quarts of water should be used to each quart of vegetables or fruit to be blanched—i. e., 3 quarts of peas should be blanched in not less than 12 quarts of boiling water if they are to be blanched together and all at the same time.

Blanching in boiling water requires only a short time. In the case of such vegetables as Lima beans or peas careful blanching for a

short period in boiling water may be of special value in helping to rinse off any loose particles that may be adhering to them and which, if allowed to cling to such products, might make the liquid in the jar cloudy. On the other hand, too long blanching helps to produce cloudiness because of overcooking and disintegration.

The steam blanch requires much more time, since in this method the heat penetrates more slowly to the center of the mass which is to be blanched. It is well to blanch only a small quantity at a time; the amount of material which will pack two or three quart jars is perhaps as large an amount as should be blanched at one time to advantage. It is therefore difficult to set a definite length of time for the steam blanch which will give exact results. The product should be blanched until it is tender enough to pack readily, but not long enough to discolor the delicate green tissues.

FIG. 7.—Cheesecloth-wrapped product being lowered into boiling water for blanching.

There is practically no loss of solids in the steam blanching, whereas it is quite plain that blanching in water causes considerable loss of juices and solids, since the water in which the blanching is done soon becomes thick and discolored and must frequently be renewed, preferably as often as used.

A steam-pressure canner may be used for steam blanching. In this case the petcock should be left open and the lid need not be clamped into position.

COLD DIPPING.

For some products, such as corn on the cob or tomatoes and peaches, which must be handled with the fingers immediately after the blanching period, it is well to plunge into cold water for a very short time, not more than 5 to 10 seconds. Dipping or rinsing after blanching may at times be advisable with certain other products, such as peas and Lima beans. The treatment may help blanched products

to some extent by further cleansing them, provided the water is clean and above reproach bacteriologically, as it should be. It also helps to remove loose starch particles in those cases where the blanching process has resulted in undue softening. Vegetables or fruit should never be allowed to soak in the cold water or to stand in it for any appreciable length of time. As a result of soaking, not only the quality deteriorates but the subsequent processing is rendered more difficult because the vegetables or fruits have been appreciably chilled. In case of those vegetables which are most difficult to can, the cold dip should be omitted or the vegetable should be rinsed in

FIG. 8.—Packing blanched and cold-dipped product into jars. Note empty jars to be packed inverted in pan of hot water. They are thus kept clean and hot.

boiling instead of cold water, or else the vegetable should be reheated after handling and just before being packed into the jar.

Immediately after blanching (and after cold dipping, if that process be practiced), the product should be well drained, handled and reheated if necessary, packed in the container, and processed at once. Do not allow fruits and vegetables to stand longer than is absolutely necessary at any stage of the canning process. If some jars must stand while others are being packed, place the jars first packed where they will keep as cold as possible (fruit packed cold before the sirup has been added) or else as hot as possible—i. e., in the canner (vegetables packed in boiling water or brine).

CANNING IN GLASS.

PACKING.

All products should be packed as soon as possible after their preparation is finished (fig. 8). After selecting the fruit or vegetable for uniformity in size and quality it should be arranged so as to give a symmetrically placed and attractive pack. In placing the product in the jar, a thin slender, flexible paddle, knife, or spatula is useful. Pack the jar as full as possible without crushing the pieces. In the case of such vegetables as greens, corn, and beans, however, one must be careful not to pack too closely, since too small an amount of liquid in the jars delays heat penetration to the center of the mass. The pack should be so loose that when the jar is inverted the contents may "settle" or slide easily and quickly (though very slightly) to the other end of the jar. Fill the jar with boiling sirup, brine, or water, according to the product packed, and add the seasonings (fig. 9). "Paddle" carefully—i. e., insert knife or spatula into the jar in such a way as to remove all air bubbles that may remain after the liquid has been added to the pack. This is particularly necessary with jars having a well-defined "shoulder," under which the bubbles may collect.

FIG. 9.—Filling jars with hot liquid after packing.

ADJUSTING THE RUBBER RING AND CAP.

Before using the rubbers should be cleansed by keeping them for at least 10 minutes in boiling water, or, if preferred, in a soda bath (1 teaspoon of soda to 1 quart of boiling water). In addition to cleaning, this soda-bath process is supposed to help to remove any undesirable odor of rubber. Put the rubber and cap of the jar into position and partially seal. When using screw-top jars screw the cap evenly about halfway down. With a wire-clamp glass-top jar place the glass top on evenly and raise the upper clamp in position to hold the lid in place; leave the lower clamp loose until after the processing period. With an automatic-seal jar fasten the cap on with the metal spring or clamp. This jar is self-sealing as it cools.

PROCESSING AND SEALING.

Processing is the final application of moist heat to preserve the product and is continued for a period determined by the character of the product, size and material of the container, and the kind of apparatus used. (See time schedule on p. 47.)

Place the jars in the canner and begin to count the time from the moment when the water boils vigorously, or when the desired pressure is reached. When the time designated for processing each product has elapsed, the jars should be removed from the steamer or hot-water bath and sealed at once (figs. 10 and 11). Do not allow jars to remain in the water until it cools. To do so would overcook many products, especially fruits, tomatoes, and vegetables of delicate flavor. Remove the jars from the canner immediately at the end of the processing period.

FIG. 10.—A tray of packed jars just after removal from the processing bath in a homemade water-bath outfit. The jars are now ready for sealing.

Care must be taken that drafts of cool air are not allowed to strike the hot jars as they are taken from the canner, as this may cause breakage. At the same time jars should not be closely stacked, since that would unduly delay cooling.

The jars, after having been sealed, should be turned upside down on a tray to cool, and should be watched very closely for leaks. In case a leak occurs, tighten the cover until the jar is completely sealed and process immediately while still hot for an additional period equal in length to at least one-third of the original processing period, or not less than 10 minutes in any case. Watch these reprocessed jars carefully for signs of spoilage.

If automatic-seal jars are used, allow them to cool before inverting and testing.

STORAGE.

When cold, store the jars in a cool, dark, dry place where there is no danger of freezing. From time to time, especially during very hot weather, all canned products should be examined to make sure that there are no leaks or signs of fermentation or spoilage.

CANNING IN TIN.

Two kinds of cans are commonly used in home canning, namely, the sanitary or rim-seal can and the cap-and-hole can. With the exception of the process of sealing, the different operations of canning are substantially the same with the two kinds of cans.

GOVERNMENT REGULATIONS FOR PRODUCTS PACKED FOR SALE.

Products packed for sale must comply with all of the regulations of the State in which they are to be sold. Information concerning these regulations may be obtained from the State board of health.

FIG. 11.—Sealing a packed and processed glass jar. Note that the wire lever has been pressed down.

If the products are to be shipped into another State they must also comply with the Federal laws, information about which may be obtained from the Bureau of Chemistry, United States Department of Agriculture. The Federal laws require cans packed for interstate commerce to be filled as full of food as is practicable for processing, and to contain only enough liquor to fill the spaces and cover the contents. The weight of solid material which a given can must contain varies with the product, with the grade of product, and to some extent with the character of the material. The Bureau of Chemistry determines from year to year what the drained contents of a properly filled can of given size should be. In determining these weights the contents are, in each instance, turned from the can upon a wire screen of $\frac{1}{8}$-inch mesh, and are allowed to drain for 2 minutes. This drained weight is then used as a standard for the solid contents of a can. With all products it is necessary, therefore, that cans should be filled as full as practicable without injury to the quality of the product. The Bureau of Chemistry has announced the weights of drained contents of different-sized cans of the following fruits and vegetables:

TABLE 1.—*Weights of drained contents of different-sized cans of fruits and vegetables.*

Product.	Can.	Size of can.		Weight of drained contents.	
		Sanitary.	Cap-and-hole.		
		Inches.	*Inches.*	*Pounds.*	*Ounces.*
Cherries, pitted:					
Packed in sirup 20° Brix, or heavier.	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			13.5
Packed in sirup 20° Brix, or lighter.	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			12.5
Unpitted cherries	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$	$3\frac{3}{8}$ by $4\frac{9}{16}$		13
Corn	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			14.5
Peas	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			13.5
Beet tops, spinach, and Swiss chard	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$	$3\frac{3}{8}$ by $4\frac{9}{16}$		15
	No. 3	$4\frac{1}{4}$ by $4\frac{7}{8}$	$3\frac{3}{16}$ by $4\frac{7}{8}$	1	9.5
Beans, wax and Refugee:					
Whole beans	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			11.5
Cut beans	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			12
Beans (green), Lima	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			13.5
Peaches	No. $2\frac{1}{2}$	$4\frac{1}{16}$ by $4\frac{11}{16}$		1	3
Pears	No. 2	$3\frac{7}{16}$ by $4\frac{9}{16}$			13
	No. 3	$4\frac{1}{4}$ by $4\frac{7}{8}$		1	6

A can of a size not mentioned here should yield a drained weight proportional to the drained weight indicated for the can nearest in size.

In the case of tomatoes no liquid may be added.

Announcements as to other products, or new standards for the products mentioned above, are made from time to time. Copies of these announcements will be sent to all canners upon request to the Bureau of Chemistry.

It will be necessary to weigh the solid contents of a sufficient number of cans before and after processing each product to obtain an accurate idea as to weight of fill necessary to give the drained weight required by law. Shrinkage or swelling during blanching and processing varies with the condition (juiciness, starchiness, etc.) of the fruit or vegetable in question.

Mark the cans with a pencil to show nature of contents.

Let one person do the packing and another attend to the weighing. Do not allow filled cans to stand before adding liquor and exhausting or processing. To do so will injure the product.

The Federal Food and Drugs Act requires all cans of fruits and vegetables shipped in interstate commerce to bear a statement of the quantity of contents. This statement must show the total contents of the can, including both solids and liquids. Most State laws have the same requirements.

ADDING BRINE, SIRUP, OR WATER.

After filling the can full of the fruit or vegetable, add boiling sirup, water, or brine to within one-fourth inch of the top. (Exception: Federal regulations forbid all such additions to tomatoes canned for sale in interstate commerce.) Shake the can gently to displace all

air bubbles; or "paddle" or stir with a flexible knife or spatula for the purpose if necessary.

EXHAUSTING.

After the sanitary cans are filled (or the cap-and-hole cans have been filled and capped) put them in trays and lower into boiling water which reaches to within 1 inch of the top. Allow the cans to remain in the boiling water only long enough to heat the contents and thus drive out the air to some extent. Ordinarily three minutes

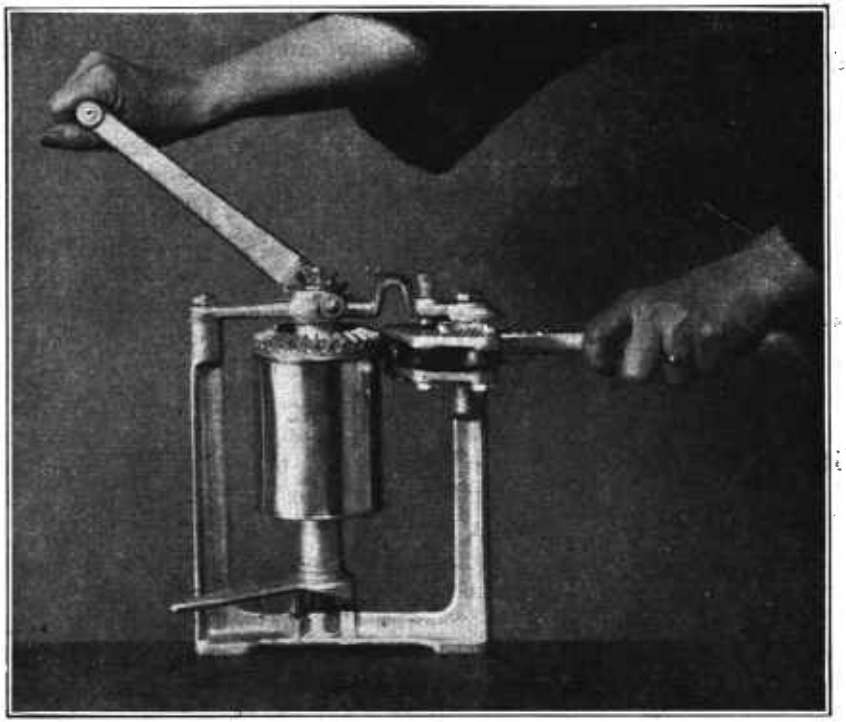

FIG. 12.—Sealing sanitary cans.

is enough. If you find that the contents of the can are hot enough to register 160° to 180° F. immediately before sealing, it is unnecessary to exhaust.

SEALING SANITARY CANS.

Immediately after exhaust (if any) the cans should be sealed at once. Two distinct operations are required to seal the sanitary or rim-seal cans. Put the lid on the can and clamp it in the machine (fig. 12). Apply the first roll gradually while the can is revolved. This operation should be continued until the cover is locked into position all the way around and the lap joint made. The second roll is then applied and the can revolved to close the joint and thus hermetically seal the can. Complete instructions are furnished with the machines.

TESTING THE SEAL OR JOINT.

To determine if the machine is adjusted properly, place three or four tablespoonfuls of water in a can and seal it. Hold the sealed can under boiling water for three or four minutes. If air bubbles rise from the can it indicates that the seal has not been properly made.

Special types of rim-seal cans should be handled according to instructions of the manufacturer.

PROCESSING.

The cans are processed for varying lengths of time, depending upon the product canned, the size and material of the container, the way in which it is packed and the extent to which it is filled, and the type of canner used.

Heat penetrates tin more readily than glass, and the difference between tin cans and glass jars is especially noticeable when processing products containing a good deal of juice or free liquid, such as peas, string beans, and asparagus. In such cases, the quart glass jar should receive about 20 minutes longer process than does the No. 3 tin can; the pint jar, 15 to 20 minutes more than does the No. 2 tin can, when the processing is done in the water bath. But in case of closely packed solid or semisolid products such as corn packed Maine style, no such distinction between tin and glass should be made, since both of them conduct heat faster than does the food material itself. The diameter of the container is therefore the important factor with such materials, and it is best for the home canner to use pint rather than quart jars or No. 2 tin cans rather than No. 3.

When canning with a steam-pressure cooker and using tin cans, the steam may be released at the end of the processing period and the cans removed at once. Since they are already completely sealed there can be no loss of liquid from the can.

All cans, if perfectly sealed, should bulge at the ends when removed from the canner. On cooling the steam is condensed, and the ends should then be well drawn in.

COOLING.

Cool all canned products as quickly as possible after the end of the processing period. This prevents any further cooking which might destroy and injure the flavor and color. Plunge the tin cans into cold water at once, changing this water frequently. Never stack cans close together before they are cold.

LABELING FOR SALE.

In labeling cans place the sealed end down, so that the opposite end will appear at the top when placed on the shelf. Use a rather dry paste and put it only on the end of the label, so that no paste will touch the can. If paste is allowed to touch the can, it may cause

rust. Where a damp climate causes cans to rust easily, the outside of the can may be lacquered before being labeled. Net weight in pounds and ounces and the packer's name and address should appear on each label.

CANNING IN CAP-AND-HOLE CANS.

Preparation for sealing.—Before beginning the canning, special equipment (including capping steel, tipping copper, fire pot for heating tools, flux, sal ammoniac, and wire solder) must be secured for the purpose of sealing the cap-and-hole tin cans. Flux is used in cleaning and retinning tools and in sealing the cans. It is brushed around the cap before the hot tool is applied and causes the solder to adhere to the tin. Rosin is sometimes used instead of flux. A soldering paste has been manufactured which is desirable for use in canning work since it is convenient and clean to handle.

Flux ready for use may be purchased at some drug stores and hardware stores, or it may be made by placing a quantity of muriatic (commercial hydrochloric) acid in a glass or crockery jar (not metal) and adding strips of sheet zinc until no more can be dissolved. To this add an equal quantity of water and label carefully. When canning have one vessel (a tin can will do) with enough flux in it to clean the tools and another (a glass jar or bottle) for the quantity to be used in cleaning and sealing the cans.

Cleaning and tinning the steel and copper.—It is of first importance to have the capping steel and tipping copper in good condition. These may need to be rubbed with coarse sandpaper or on a soft brick to smooth them, or the steel may have to be filed to remove the rust. In the latter case great care must be taken to keep the edge of the steel true. Both the capping steel and the copper must be kept coated with solder to make the solder flow evenly when sealing. Place a handful (5 or 10 cents' worth purchased at a drug store) of powdered sal ammoniac, and a few pieces of solder, in a can. Heat the already smoothed capping steel and tipping copper until almost red hot, dip them into the flux and then into the sal ammoniac and solder, turning them about and rubbing them until well coated with solder. Then dip in the flux again.

PACKING.

Same as for sanitary cans, page 31.

FLUXING AND CAPPING.

When the can has been filled as already described, clean and wipe the groove around the opening, put the cap into place, and solder according to the following directions:

Arrange the cans which have been filled in rows upon the table so that they may be handled as rapidly as possible. Place a finger on the vent hole to hold the cap in place, apply the flux carefully around

the groove and solder-hemmed cap, making sure that none of it enters the can. The flux is used to make the solder adhere to the tin. It may be applied with a brush, or with a little mop made by tying a piece of clean white cloth around the end of a small stick. Then take the capping steel from the fire and insert the center rod or upright steel in the center of it. Hold the capping steel above the cap until the center rod or upright steel touches the cap and holds it in position (fig. 13). Then apply the capping steel, holding the cap in place with the center rod while lowering the steel, and turn it steadily back and forth until the solder flows. Do not bear down on the capping steel. Remove the capping steel by holding the center rod firmly and lift the steel with a sudden twist to swing the melted solder around the groove evenly. Inspect the joint carefully and if any pinholes are found, recap, or repair with the tipping copper. It may be necessary to use a piece of wire solder or a waste solder rim from a cap to add more solder to a broken place in the joint.

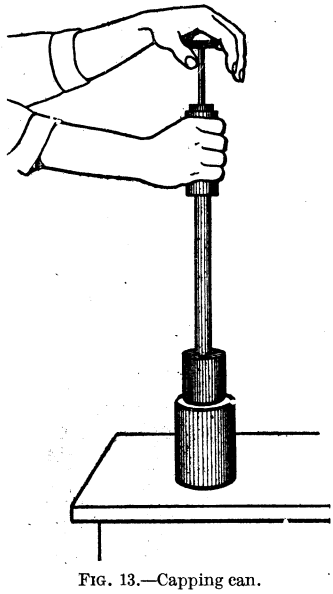

FIG. 13.—Capping can.

EXHAUSTING.

Same as for sanitary cans, page 33.

TIPPING OR SEALING.

Immediately after exhausting, close the small hole in the top of the can. Apply the flux as for capping, taking care that no flux enters the can (fig. 14). Use wire solder, holding it in the left hand with the point directly over the hole. Touch the point of the wire solder lightly with the hot copper so that only a bead of solder will drop and cover the hole. This makes a neat tip.

PROCESSING, COOLING, AND LABELING.

Same as for sanitary cans; see page 34.

DIRECTIONS FOR CANNING DIFFERENT KINDS OF FRUIT.

SIRUPS FOR CANNING.

Fruits are usually canned in sirups which in most cases are made of sugar and water in varying proportions. In the case of some fruits such as berries, the fruit juice itself may be used instead of water for making sirups. The sirup is made by adding the sugar to the water (or fruit juice) and bringing the entire mixture to the boiling point. Strain through cheesecloth and use while boiling hot.

Sirups of varying densities are employed, depending upon the character of the fruit to be canned. In each case the sirup has been selected with reference to securing good color, preserving the texture, and retaining the natural flavor of the fruit. Thin sirups (10 to 20 per cent sugar; see Table 2) may be used for all very sweet fruits, such as sweet cherries, peaches, and some berries. A slightly heavier sirup (20 to 30 per cent sugar) may be used for medium sweet fruits. Sour fruits, such as gooseberries, plums, sour cherries, apricots, etc., require a medium thick (40 to 50 per cent sugar) or even a heavy sirup (60 per cent sugar). These sirups for canning purposes range in density from 10° to 60° as measured by a Balling or Brix saccharometer, which means that from 10 to 60 per cent by weight of the sirup is sugar.

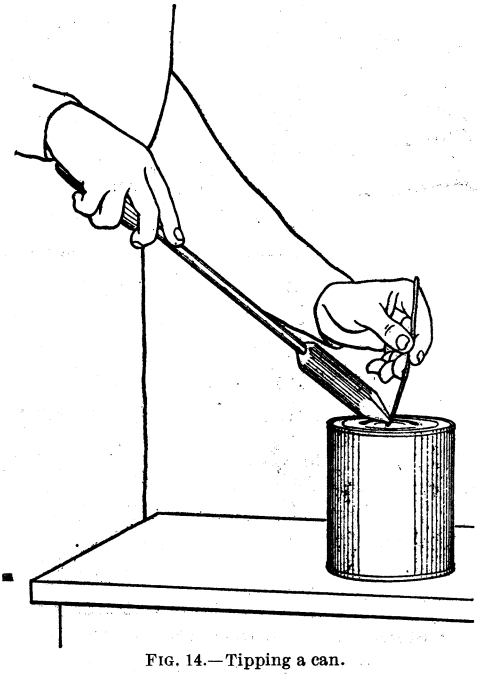

FIG. 14.—Tipping a can.

HOW TO DETERMINE SIRUP DENSITY.

Unsatisfactory results frequently follow the use of sirups which are not of the density best suited to the particular purpose for which they are employed. The following table gives the approximate proportions of sugar and water required to prepare sirup of a given density. In the absence of a saccharometer, these proportions, either by weight or by measure, may be used to secure sirups of the desired consistency:

TABLE 2.—*Table for making sirups.*

Number of sirup.	Sugar.				Water measure.	Percentage of sugar (approximate).	Density (Balling scale).	Character of sirup.
	Weight.		Measure (approximate).					
	Lb.	*Oz.*	*Cups.*	*Pints.*	*Quarts.*		°	
1		15	2	1	[1] 4	10	10	Very thin.
2	2	1	4	2	4	20	20	Thin.
3	3	9	6½	3	4	30	30	Thin or medium.
4	5	9	10	5	4	40	40	Medium.
5	8	5	16	8	4	50	50	Thick.
6	12	8	24	12	4	60	60	Very thick.

[1] 3,784 grams.

In Table 2 no allowance is made for evaporation of water during cooking of the sirup; but if the sirup be merely brought to the boiling point and then taken at once from the fire, the error thus introduced is so small that it may safely be disregarded.

CANNING FRUITS WITHOUT SUGAR.

All fruits may be canned successfully for future use for jelly making, pie filling, salad purposes, etc., without the use of sugar, by adding hot water (or better still, hot fruit juice) instead of the hot sirups. Hot-water products can hardly be expected to be as good either in texture or in flavor if served in the place of fresh fruit or in the form of a sauce as are those which are canned in sirup. But fruits canned in their own juices are often highly satisfactory, particularly if they are very ripe and sweet—e. g., a peach which is naturally high in sugar content may seem as sweet when canned without sugar as does an acid peach canned in a 40 per cent sirup.

PROCESSING.

Because of their acid content, most fruits are easily and successfully canned by the short application of a moderate degree of heat. After the fruit is packed into the jars, fill them with hot sirup (or boiling water or juice), placing the lids loosely into position. Then the jars are put into a hot-water bath or household steamer or a water-seal canner, and processed for the length of time designated in the table. The length of the processing period varies with the type of canner used, with different fruits, with the ripeness and condition of the fruit, and with the way in which the fruit is packed—i. e., a close pack with a small amount of liquid, such as apple sauce, or tightly packed sliced peaches rather than halves loosely packed, requires a longer processing period. If any considerable time elapses between the filling of the first and last jars, pains should be taken to see that the jars first packed do not receive an unduly long process.

For high altitudes, where the boiling point of water is considerably below 212° F., it is necessary to increase the length of the processing period 10 per cent for each additional 1,000 feet in altitude above the first thousand. (See Table 6, p. 48.) Thus, if at an altitude of 3,000 feet one is canning fruit or vegetables which at sea level require a processing period of 30 minutes, this period must be increased by 2 times 10 per cent of 30 minutes, or 6 minutes, making a total processing period of 36 minutes. For very high altitudes it may be advisable to use a steam-pressure cooker for processing certain fruits as well as for vegetables. In this case, most of the fruit canning should be done at 5 pounds of pressure or even less, since the higher temperatures tend to destroy both the texture and flavor of the fruit. (See Table 3, p. 47, column 6.)

If it is necessary to use a pressure cooker for processing fruits at ordinary altitudes, the petcock should be left open during the process. This reduces the pressure to atmospheric, and the time should be counted the same as in the water bath-method. If preferred, the petcock may be left open, and the canner may be filled to the depth of 8 or 10 inches with water and used as an ordinary hot water bath canner.

In the following instructions for canning, when two different times of processing are indicated (as, "40 to 60 minutes at 10 pounds pressure"), the longer time should be used for quart glass jars, the shorter time for tin cans (see also Table 3, p. 47). Furthermore, an unusually tight pack is an additional reason for increasing the length of process. Also, good judgment must be exercised to make sure that the process applied is appropriate to the condition of the product being canned. For example, small juicy young peas may be sadly overcooked by a process of 60 minutes at 10 pounds, which might under some circumstances be necessary for peas of the larger sizes; a tender, juicy freestone peach should ordinarily be processed no more than 20 minutes, whereas a firm clingstone requires 30 minutes.

APPLES.

Whole apples.—Apples may be baked in their skins or they may be pared and cored and cooked in a medium sirup until clear and transparent; pack while very hot in hot wide-mouthed jars or cans; fill jar with hot sirup; process in water bath 10 minutes; remove and seal at once; store properly when cool.

Sliced, quartered, or halved.—Select firm, sound apples. Carefully peel and core them. Cut into slices or halves. If any length of time is allowed to elapse between peeling and blanching the fruit may tarnish. To prevent this it may be immersed in very cold slightly salted water until ready for blanching, but it must not soak long in water. Blanch 1½ minutes in steam or boiling water; or cook in a very small amount of water until well shrunken; and pack closely in hot jars or enamel-lined tin cans. Cover with No. 1 sirup (boiling hot), or with boiling fruit juice. Place rubbers and caps of jars in position, or seal tin cans. Process in water bath or water seal for 20 to 30 minutes. (If cooked until shrunken and packed hot, process only 10 minutes.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

Apple sauce.—This method is more economical of space than is the canning of whole or sliced apples, and second-grade apples may well be preserved in this manner. The apples should be pared and sliced, steamed until done, and passed through a sieve. Add 1 cup of sugar to each gallon of pulp, reheat until the sugar is dissolved, pack at once (while boiling hot), and process quart jars in water bath or water seal for 10 to 20 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

APRICOTS.

Follow the directions given for Peaches.

BERRIES.

For dewberries, huckleberries, raspberries, blackberries, loganberries, blueberries, strawberries, grapes, and currants practically the same methods of canning may be used. Glass jars or enamel-lined cans are needed. The condition of the fruit will have much to do with the quality of the product. Berries should be gathered in shallow trays or baskets and not in deep vessels which allow them to be bruised or crushed. They should be uniformly ripe and sound, and as large as possible. Sort

the berries carefully; remove stems or hulls from the berries, grapes, or currants. Place a shallow layer of the fruit in a large colander or strainer and wash carefully by pouring water over them, or by dipping the colander cautiously in and out of the water, instead of by immersing them for some moments in water. Pack in hot jars as closely as possible without crushing. This may be done by putting a few berries at a time into the jar and gently pressing them into place. (Three-fourths of a pound, or ¾ quart, of most of the commoner sorts of berries, measured as purchased, will pack into one pint jar.) Proceed layer by layer until the jar is full. Fill jars with No. 3 sirup (hot) or use No. 4 or No. 5 sirup in case of loganberries, currants, and some varieties of strawberries. Process pint jars in water bath or water seal for 10 to 15 minutes; quart jars for 15 to 20 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

When canning in tin, the enamel-lined cans must be used for all highly acid berries.

If, in making the sirup for berries, the berry juice is used instead of water, the resulting product will be much better both in color and in flavor.

When strawberries are canned by the following method they will not rise to the top of the sirup: Use only fresh, firm, ripe, and sound berries. Remove the hulls and wash by placing a shallow layer in a colander and pouring cold water over them. Add 8 ounces (1 cup) of sugar and 2 tablespoons of water to each quart of berries. Boil slowly for 15 minutes in an enameled or acid-proof kettle. Allow the berries to cool and remain several hours or overnight in the covered kettle. Pack the berries in hot glass jars or enameled-tin cans. Heat the sirup that remains in the kettle and fill the jars or cans. Process in water bath or water seal for 20 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

CHERRIES.

When cherries are canned without removing the pits, it is well to blanch them for 15 seconds to prevent splitting. For sour cherries use No. 4 sirup, and for sweeter ones No. 3. Use glass jars or enamel-lined cans. Process in water bath or water seal for 25 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

FIGS.

Figs for canning should be sound and firm. Sprinkle 1 cup of soda over 6 quarts of figs and add 1 gallon of boiling water. Allow the figs to stand in this soda bath for 5 minutes. Drain and rinse thoroughly. Bring 2 quarts of No. 3 sirup to the boiling point and add the well-drained figs. Allow the fruit to boil in this sirup for 1 hour. Place the fruit carefully in the hot jars and then fill them with the sirup. Process in water bath or water seal for 30 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

FRUIT JUICES.

Method I.—The juice may be pressed out of uncooked fruit by means of a cider-press, a special fruit press, or by improvised presses; it should then be warmed in an enamelware kettle up to 110° F. It may then be poured into ordinary hot jars or hot bottles which have been boiled for 30 minutes, and (in many cases) processed by the same directions as those for canning the fruit itself. If poured into bottles of miscellaneous shapes and sizes, it is suggested that the fruit juice be processed as follows:

Use new corks and dip them in melted paraffin. Put the stopper lightly into the bottle, and leave it in during the processing period. Set the bottles into hot water up to the neck and process the juice for 30 minutes at a temperature of 180° F. Remove the product and immediately press the cork in as tightly as possible. Certain fruit juices (including those of sour cherries, peaches, and apple cider) handled in this way are less likely to "flatten in taste" and will keep fresh for future use.

Method II.—The juices of such fruits as grapes, black and red currants, blackberries, black raspberries, elderberries, and cherries make delicious and wholesome drinks and should be used more freely in the home. The flavor of these juices is finer if they are pressed from cooked fruit and processed at a temperature below the boiling point. Select sound ripe fruit, crush and heat slowly to the simmering point (about 185° F.). Strain through a double thickness of cheese cloth. If juice free from sediment is desired, let it stand in a cool place for a few hours. Then pour off (or siphon) carefully from the dregs.

The addition of sugar to the fruit juices will give a finer flavor. It may be used in any desired proportion, a fair allowance being 1 cup of sugar to 1 gallon of juice.

Pour the warm juice into scalded bottles, put scalded stoppers in lightly, set the bottles on a rack in the water bath, and process for 30 minutes at simmering point (about 180° F., or a little lower than the heat at which the fruit was cooked). Remove from the bath, tighten the stopper, and when the bottles cool dip the tops into melted paraffin or sealing wax. A good wax may be made by melting together equal parts of rosin and beeswax.

These homemade fruit juices will be excellent for use in gelatin desserts, puddings, sauces, ice cream, sherbet, etc. If bottled without any sugar, they are useful for making jelly. This method for making grape jelly just as it is needed does away with the tartrate crystals which are so objectionable in it, since these crystals form only after the jelly has stood for some time.

Further information concerning the preparation of fruit juices may be obtained from department publications.[1]

GOOSEBERRIES.

Select the firm berries, discarding any which are spotted or the skins of which are broken. Wash and pick over berries and pack them into scalded jars. Fill with sirup No. 4 (boiling hot). Process in water bath or water seal for 15 to 20 minutes. Remove the jars from the canner and seal at once. When cool, store in a dark, dry, cool place.

Gooseberry sauce.—Prepare the fruit as for canning. Add a small amount of water to the berries and boil until the fruit is cooked to a pulp. To each quart of this pulp add ½ cup of sugar, or more if preferred. Heat until the sugar is dissolved, and while boiling hot pack in hot jars. Process in water bath or water seal for 10 minutes. Remove the jars from the canner and seal at once. When cool, store in a dark, dry, cool place.

GRAPES.

Follow directions given for berries.

GRAPE JUICE.

Treat as above in Method II under "Fruit Juices," or consult special methods given in publications referred to in the footnote.

GUAVAS.

Only firm, sound guavas should be used for canning. Pare the fruit, cut it into halves, and remove the seeds. Float the halves in boiling water for 20 seconds. Drain and pack carefully as for peaches. Fill the jars to overflowing with No. 4 sirup and process in water bath or water seal for 25 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

PEACHES.

Before preparing fruit make sirup No. 2 or No. 3 (or richer if desired), allowing 1 cup of water for each quart jar. Put in one cracked peach pit for every quart of sirup. Boil 5 minutes and strain.

Sort the fruit, using firm, uniform peaches for canning. Put aside the soft broken ones for jam or butter. Immerse the peaches in boiling water about 1 minute or until the skins will slip easily, plunge at once into cold water for a few seconds. Remove the skins, cut the peaches into halves, and discard the pits. Pack at once, placing the halves in overlapping layers, the concave surface of each half being downward and the blossom end facing the glass. Fill each jar with sirup and paddle or stir carefully with spatula to remove air bubbles. Process in water bath or water seal for 30 minutes if the fruit is quite firm and hard, or for 20 minutes if it is ripe and tender. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place. These directions apply to apricots also.

PEARS.

Select firm, ripe pears. Peel, cook for 4 to 8 minutes (according to size) in boiling sirup (No. 3). This preliminary cook is given in order to make hard varieties of pears pack better. Pack the pears into jars or cans, and pour hot sirup over them to

[1] Farmers' Bul. 758, Muscadine Grape Sirup; and Farmers' Bul. 1075, Unfermented Grape Juice—How to make it in the Home.

fill the container. When packed whole, leave stems on and place each layer, stems up, letting each succeeding layer fill the spaces between the stems of the previous layer.

When the jars have been packed with fruit, fill with sirup No. 3 and process in water bath or water seal for 30 minutes for large pears or 20 minutes for small ones. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

PINEAPPLE.

Use sound, thoroughly ripened fruit. Peel and core it, remove all eyes carefully. Cut into convenient cross sections and pack into glass jars or enameled tin cans. Fill with No. 2 sirup (or richer, if desired; in any case boiling hot). Process in water bath or water seal for 30 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

To shrink the fruit somewhat, it may be put into a kettle, covered with sirup, and brought slowly to a boiling point; then packed (boiling hot) into jars or cans and processed for 20 instead of 30 minutes.

PLUMS.

Select firm, uniform fruit. Pack as firmly in jars or enamel-lined cans as is possible without crushing. If the skins of the plums have been pricked in several places it may perhaps help to keep them from bursting. Fill with No. 4 or No. 5 sirup, in case they are quite acid, otherwise with No. 3. Process in water bath or water seal for 20 to 30 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

RHUBARB.

Select young, tender stalks; trim and wash carefully and cut into 1 or 2 inch lengths. Pack these into scalded glass jars and cover with No. 4 or No. 5 sirup (boiling hot). Place a scalded rubber and cap in position and process in water bath or water seal for 20 to 30 minutes. Remove the jars from the canner and seal at once. When cool, store in a dark, dry, cool place.

Rhubarb sauce.—Since rhubarb contains much water a more economical product may be secured by canning rhubarb sauce. Cut the rhubarb into inch lengths and steam or boil with 1 or 2 tablespoons of water until tender. For each quart of sauce add ½ cup of sugar. Pack hot in scalded glass jars and process in water bath or water seal for 10 to 20 minutes. Remove the jars from the canner and seal at once. When cool, store in a dark, cool, dry place.

DIRECTIONS FOR CANNING DIFFERENT KINDS OF VEGETABLES.

ASPARAGUS.

It is of the greatest importance that asparagus for canning be fresh and tender. Select tips of uniform size and maturity and wash them well. Cut in right lengths for the cans, scrape off tough outer skin with scales, and tie in bundles. Blanch by immersing the lower ends in boiling water for 2 minutes, then the entire stem for 2 minutes longer. Plunge into cold water for an instant only, drain and pack carefully into glass jars or enamel-lined tin cans, with the tips up. Fill the jars with brine (4½ ounces salt to 1 gallon water) and process pint jars under 10 pounds pressure for 30 to 40 minutes. (For water bath and water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

BEANS, STRING.

Either the green string bean or the wax bean may be used. The beans should be tender and fresh. When the beans within the pod have grown to any considerable size canning is more difficult and the product of poorer quality from a commercial standpoint. For canning, only well-sorted, small, tender beans should be used. String the beans and cut them into 2-inch lengths. Cutting diagonally or "on the bias" gives an attractive product. Very small, tender beans may be canned whole. Blanch 3 to 5 minutes in boiling water, or 5 to 10 minutes in live steam. Drain well and pack immediately into hot glass jars or in tin cans. Add boiling water to cover and 1 level teaspoonful of salt per quart. Paddle or stir to remove all air bubbles. Process under 10 pounds steam pressure for 40 to 50 minutes. (For water bath and

water seal, see p. 46). Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

BEANS, LIMA.

The beans should be gathered when in prime condition. The very small tender beans are more easily canned, since the mature beans, or those which have grown starchy, seem to be more difficult to can successfully. Wash, hull, and sort carefully. Blanch 3 to 5 minutes in boiling water, or 5 to 10 minutes in live steam; pack immediately into hot jars or cans. Fill the container with boiling water, and paddle or stir to remove air bubbles. Add 1 level teaspoonful of salt, and, if desired, 2 level teaspoonfuls of sugar, per quart. Process under 10 pounds steam pressure for 45 to 60 minutes. (For water bath or water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

BEETS.

From the standpoint of quality, only young, tender beets should be canned. Grade according to size and color. In preparing beets for blanching, be careful to leave them with at least 1 inch of the stem and all of the root. This will help to prevent loss of juice with accompanying loss of color and flavor. Wash thoroughly and blanch 5 to 10 minutes, or until the skins will slip easily. Dip for only an instant into cold water if this is considered desirable in order that they may be more easily handled. Drain and peel by slipping the skins from the beets. Pack whole, if possible, in layers of three or four, fitting the second layer into the spaces left by the first, and repeat until the jar (or enamel-lined can) is full. Cover with boiling water, and process in water bath or water seal for 180 minutes or under 15 pounds steam pressure for 60 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

For canning in tin, use enameled or lacquered cans.

Well-canned beets may show a slight loss of color when first removed from the canner, but often brighten up within a few days.

CARROTS.

Young, tender carrots should be used. Grade as to size and color. Wash carefully and blanch in boiling water for 3 to 5 minutes. Remove and dip quickly into cold water. Drain and peel. Pack carrots whole or sliced, in hot glass jars or tin cans. Add boiling water to cover, and 1 level teaspoonful of salt to the quart. Process in water bath or water seal for 180 minutes or under 5 pounds steam pressure 60 minutes, or 10 pounds for 40 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

When canning larger carrots, pare and slice crosswise, and blanch in steam for 15 minutes. Pack into hot glass jars or tin cans and proceed as above.

CORN.

Much depends upon careful selection of tender, juicy corn before it reaches the starchy stage. Corn that has reached the dough stage before being canned will have a cheesy appearance after canning. When it has passed the milky stage or is stale, it is very hard to can successfully. Corn should not be allowed to stand after being taken from the stalk. Blanch on the cob 1 to 5 minutes according to the size of the kernels. Dip into cold water for an instant. Remove and cut the corn from the cob without scraping, i. e., Maryland style, using a sharp, thin-bladed knife. Best results are obtained when one person cuts the corn and another fills the containers. If one person works alone, he should cut off sufficient corn to fill one jar, add the boiling water, cook in a saucepan, fill the jar and put it into hot water bath or steam canner at once. A good proportion to use is half as much, by weight, of water as of corn. Put the corn in a kettle, add boiling water to cover and 1 teaspoonful of salt and 2 teaspoonfuls of sugar to each quart of corn. Allow all to come to the boiling point and pour immediately into hot jars, being sure that the water covers the corn well. Fill jars to within 1 inch of top, cans to within $\frac{1}{2}$ inch. Process under 15 pounds steam pressure 60 to 90 minutes. (For water bath and water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cooled, store in a dark, dry, cool place.

When canning in glass jars at high temperatures (10 and 15 pounds steam pressure), the corn may become darkened, but this detracts from appearance rather than from the flavor, up to a certain point.

GREENS OR POTHERBS.

A large number of cultivated and of wild greens are edible and wholesome, and if canned make succulent and valuable food for the winter and spring months. Among the cultivated greens are Swiss chard, kale, Chinese cabbage leaves, French endive, cabbage sprouts, turnip tops, young, tender New Zealand spinach, dandelion, young, tender dasheen sprouts, native mustard, Russian mustard, collards, and tender rape leaves. Of wild greens the dandelion is the most common.

Can greens as soon as possible after they are picked. Sort thoroughly, allowing no foreign weed leaves or other vegetable matter to remain. Wash well in several waters, drain, and blanch for 15 minutes in live steam or 4 minutes in rapidly boiling water. Remove and place on a cutting board and cut into convenient lengths. Return to a kettle and reheat. Pack as hot as possible in hot jars or cans, being careful not to pack too tightly. (See p. 12.) Add boiling water to cover, being careful to remove all air bubbles. Season to taste. Process under 10 pounds steam pressure for 90 minutes. (For water bath or water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

OKRA.

Use only young, tender pods. Remove stem without cutting into pod, blanch 6 to 8 minutes, then plunge into cold salt water (1 tablespoonful of salt to 1 quart of water) for an instant. Pack in the cans or jars and cover with boiling water. Add 1 teaspoonful of salt to each quart. Process under 10 pounds of steam pressure for 30 minutes. (For water bath or water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

PEAS.

Use fresh young peas. They are best gathered in the early morning or when cool. Work should be done rapidly, and the peas should not stand either before or after being shelled. Wash, shell, and sort, putting peas of the same size and degree of maturity together. When canned for market or for a fancy pack, the peas are usually graded by passing them through wire screen sieves, the meshes of which range from nine thirty-seconds to fourteen thirty-seconds of an inch in diameter. Be sure not to use the harder or nearly ripe peas among tender ones.

Blanching is very important. If well done, it helps to prevent cloudy liquor, makes the peas more tender, and also removes some of the gluey substance which may coat them. Blanch three to eight minutes, depending upon the maturity of the peas. If starchy, plunge for an instant only into cold water. Drain and pack to within one-half inch of the top of the jar. If the container is filled too full, some of the peas may burst and make the liquor cloudy. Fill the jar with boiling water and paddle or stir well to remove air bubbles. Add 1 teaspoonful of salt and 2 teaspoonfuls of sugar to each quart and process under 10 pounds steam pressure for 40 to 50 minutes. (For water bath and water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

A cloudy or hazy appearance of the liquid of peas which are keeping well indicates that the product was roughly handled in blanching, or that split or broken peas were not removed before packing. Peas which are too mature or too much cooked in the blanch may burst, allowing the starch to escape into the surrounding liquid. Then, too, some waters of high mineral content have a tendency to increase cloudiness and may harden the peas.

SPANISH PEPPERS, PIMIENTOS.

The fruit of these peppers has a very thick flesh, tough skin, and is comparatively smooth and free from ridges. Peppers should be ripe, sound, and free from bruises. Sort, using the whole peppers for canning and small or broken peppers for products, such as sauces, soups, chutneys, and relishes. Prepare for peeling by placing peppers in a hot oven for six or eight minutes, being careful not to allow them to become hot enough to discolor. Peel, cut out stem, remove seeds, and pack dry in flattened layers. No water or seasoning is used in the preparation of these peppers. The processing brings out a thick liquor, which almost covers them in the cans. Process pint cans in water bath or water seal for 30 minutes. Remove the cans from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

POTATOES, SWEET.

The canning of sweet potatoes with uniformly successful results is sometimes very difficult. A sweet potato which is dry and mealy when canned is desirable. Use potatoes soon after thay have been dug, or cure promptly and then can. Wash, and boil or steam 10 or 15 minutes or until the skins slip readily. (In case of very large potatoes they may be steamed for 10 to 15 minutes at 10 pounds steam pressure.) Peel quickly and pack hot. Pack tightly and as full as possible. Process in water bath or water seal, continuously, for 3 to 5 hours, according to size. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

PUMPKIN.

Select firm, ripe pumpkins, remove the stem and cut into halves. Scrape out the seeds and spongy pulp. Cut each half into strips 1½ to 2 inches in width, and with a sharp knife cut off the outer rind. Cut the strips into convenient lengths and blanch in steam 10 to 15 minutes or until tender. These pieces may be put through a sieve or colander before packing if desired; in this case heat in double boiler almost to boiling point. Pack at once into hot jars or enamel-lined cans; add salt and other seasonings or spices if desired. Process under 15 pounds steam pressure for 90 minutes, or in water bath or water seal for 2 to 5 hours. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

SPINACH.

Many environmental conditions affect the bacterial flora of spinach (and presumably also of other greens) to a very marked extent. Upon some occasions it has been found that a processing period prolonged even to 3 hours is not sufficient to preserve the product, whether the processing be done continuously or intermittently. Apparently, however, there have been a great many cases in which spinach and other greens have been successfully canned by processing for 2 hours in the water bath.

The amount of vegetable filled into the can is one of the most important factors which determines the efficiency of the heating process which the can receives. It is possible to pack 4 pounds of spinach (washed and trimmed, weighed before blanching) into a quart glass jar; but it was not found possible in the Experimental Kitchen of the Office of Home Economics to can spinach successfully by the water-bath method when the jars were so tightly packed.

On the other hand, it must be remembered that shrinkage during blanching and processing is sometimes very great in case of tender, juicy spinach. In canned spinach which is to be sold in another State the pack must be tight enough so that the "cut out" weight (weight of the drained vegetable taken out of the can) does not fall below the standard set by Federal regulations. (See p. 31.)

Use only fresh, crisp spinach. Prepare by cutting off all dead leaves, roots, and tough stems. Cover each peck of spinach thus prepared with scalding water and allow it to stand for 1 to 2 minutes. (This helps to loosen dirt and grit.) Wash thoroughly through several cold waters and drain well. Blanch 4 minutes in boiling water or 15 minutes in steam. Drain well and pack into hot jars or cans, cover with boiling water, paddle or stir to exclude all air bubbles, and add 1 teaspoonful of salt and other seasonings if desired. Process under 10 pounds steam pressure for 90 minutes. (For water bath or water seal, see p. 46.) Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

SQUASH, WINTER.

Prepare as for pumpkin. (Use enameled cans for canning in tin.)

TOMATOES.

Select firm, uniformly red, ripe tomatoes of medium size and uniform shape. Do not use tomatoes which are overripe or parts of which are spotted or decayed. If it is necessary to cut out a portion of a tomato, it is advisable to discard the whole tomato rather than risk the contamination of an entire lot of good tomatoes, by the use of one which has begun to decay. Put into trays or shallow layers in wire baskets and blanch in boiling water 1 to 1½ minutes, according to ripeness. Remove and plunge quickly into cold water for an instant. Drain at once and core and peel promptly. Pack into jars or cans as closely as possible to prevent undue shrinkage and to help drive out the air. (Avoid crushing tomatoes if they are to be packed whole.) For home use, fill with a thick tomato sauce or with the juice of other tomatoes; but if the tomatoes are to be sold under Federal regulations add neither juice nor

water. Season with 1 teaspoonful of salt and 2 teaspoonfuls of sugar per quart. Process in water bath or water seal for 25 to 30 minutes or under 5 pounds steam pressure for 15 minutes or under 10 pounds for 10 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

VEGETABLE PUREES AND SOUP MIXTURES.

Tomato sauce or puree.—If a more economical utilization of space within the jar is desired, a more concentrated mixture can be packed. This method also provides for the use of small or broken tomatoes and large tomatoes unsuitable for canning.

Cut the tomatoes into medium-sized pieces; add 1 large onion chopped and 1 cup of chopped fresh pepper to each gallon of tomatoes. Cook until tender, put through sieve, and add 1½ teaspoonfuls of salt and 3 teaspoonfuls of sugar to each gallon of pulp. Cook until the consistency of ketchup, stirring constantly. Pack while boiling hot into jars and process in water bath or water seal for 25 minutes or under 5 pounds steam pressure for 15 minutes or under 10 pounds for 10 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

Corn and tomato.—Prepare each vegetable as for canning. Chop the tomatoes into medium sized-pieces or heat to the simmering point and put them through a sieve. Mix thoroughly 2 parts of tomatoes to 3 parts of corn. Pack into hot glass jars or enameled tin cans. Add 1 level teaspoonful of salt. Process in water bath or water seal for 2 hours or under 10 pounds steam pressure for 60 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

Concentrated vegetable soup mixture.—Any desired mixture of vegetables may be packed for home use. A good combination consists of 1 quart of concentrated tomato pulp, 1 pint of corn or tiny lima beans, 1 pint of okra, 1 small onion chopped, ½ cup of chopped sweet red pepper, 1½ teaspoonfuls of salt, and 3 teaspoonfuls of sugar. Cook the tomatoes, pepper, and onion; put through a sieve to remove seeds and cook down to about the consistency of ketchup. Measure, add the corn or beans and okra, which have been prepared as for canning. Add the seasoning and cook all together for 10 minutes. Pack at once into hot jars, and process in water bath or water seal continously for 2 hours or under 5 pounds for 60 minutes or under 10 pounds steam pressure for 40 minutes. Remove the jars from the canner and seal at once. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place.

DIRECTIONS FOR PROCESSING ASPARAGUS, BEANS, CORN, GREENS, OKRA, PEAS, AND SPINACH IN A WATER BATH.

If it is not possible to secure a steam-pressure cooker for canning these vegetables, they may often be successfully canned in a boiling water bath. However, this method is not recommended for regions where botulism is known to occur, nor where spoilage of home canned vegetables frequently takes place.

Either the continuous or the intermittent process may be used with the water bath, as indicated below. The choice of process, whether intermittent or continuous, and the exact details of the procedure to be followed will depend to a large extent upon the conditions under which the canning is to be done (p. 14). As to the procedure which should be followed under any given set of conditions it would be well to ascertain the experience of the State agricultural college, which is most likely to know what is best to be done under local conditions, and to follow its directions explicitly.

Asparagus.—Water bath or water seal. Process pints intermittently for three periods of 1 hour each, with intervals between the periods of 12 to 18 hours; or process in boiling water continuously for 3 hours. The continuous process should be used only if the asparagus is very young and tender and if canning is done in a comparatively cold climate.

Beans, lima.—Water bath or water seal. For more mature beans, process in pint jars only, continuously for 3 hours; or intermittently, as in case of asparagus or corn.

Beans, string.—Water bath or water seal. Process continuously 3 hours; or intermittently, as for asparagus or corn.

Corn.—Water bath or water seal (pint jars only). Process intermittently, as for asparagus, but for 3 periods of 1½ hours each; or continuously 3 to 6 hours.

Greens.—See spinach.

Okra.—Water bath or water seal. Process intermittently, as for corn.

Peas.—Water bath or water seal. Process continuously 3 hours; or intermittently, as in case of asparagus or corn.

Spinach.—Water bath or water seal. Process continuously 3 hours.

SUMMARY TABLES.

TABLE 3.—*Time required for blanching and processing fruits and vegetables.*

Product.	Glass jar.	Tin can.	Blanch or cook.	Water bath at 212° F.	Steam pressure.		
					5 pounds, 228° F.	10 pounds, 240° F.	15 pounds, 250° F.
					Minutes.	*Minutes.*	*Minutes.*
Apples—whole, packed hot.	Pint or quart.	No. 2, 2½, or 3.		10 minutes			
Apples—sliced, quartered, or halved.	do	do	1½ minutes	20 to 30 minutes, or 10 minutes if packed hot.	10		
Apple sauce	do	do		10 to 20 minutes	10		
Apricots	do	do	1 to 2 minutes	30 minutes	10		
Asparagus[1]	Pint	No. 2	4 minutes			30 to 40	
Beans, string	Pint or quart.	do	3 to 5 minutes in water, or 5 to 10 in steam.			40 to 50	
Beans, lima[1]	Pint	do	do			45 to 60	
Beets	Pint or quart.	do	5 to 10 minutes	180 minutes			60
Berries, etc	do	No. 2, 2½, or 3.		10 to 20 minutes	10		
Blackberries	do	do		do	10		
Blueberries	do	do		do	10		
Carrots	do	No. 2	3 to 5 minutes	180 minutes	60	40	
Cherries	do	do	¼ minute	25 minutes	10		
Corn, sweet,[1] Maryland style.	Pint	do	1 to 5 minutes				60 to 90
Currants	Pint or quart.	No. 2, 2½, or 3.		10 to 20 minutes	10		
Dewberries	do	do		do	10		
Figs	do	No. 2	5 minutes in soda; 60 minutes in sirup.	30 minutes	25		
Gooseberries	do	No. 2, 2½, or 3.		10 to 20 minutes	10		
Gooseberries—sauce (packed hot).	do	do		10 minutes	5		
Grapes	do	do		10 to 20 minutes	10		
Greens	do	No. 2	4 minutes (15 minutes if in steam).			90	
Guavas	do	No. 2 or 3	⅓ minute	25 minutes	15		
Huckleberries	do	No. 2, 2½, or 3.		10 to 20 minutes	10		
Loganberries	do	do		do	10		
Okra	Pint	No. 2	6 to 8 minutes			30	
Peaches	Pint or quart.	No. 2, 2½, or 3.	1 minute	20 to 30 minutes	10		
Pears	do	do	4 to 8 minutes in sirup.	do	10		
Peas	Pint	No. 2	3 to 8 minutes (water or steam).			40 to 50	
Peppers, pimientos.		No. 1 or 2	6 to 8 minutes in oven.	30 minutes			
Pineapple	Quart	No. 2 or 3		do	10		
Plums	Pint or quart.	No. 2, 2½, or 3.		20 to 30 minutes	12		
Pumpkin	do	No. 2	10 to 15 minutes in steam.	120 to 300 minutes			90
Raspberries	do	do		10 to 20 minutes	10		
Rhubarb	do			20 to 30 minutes	10 to 15		
Rhubarb sauce (packed hot).	do			10 to 20 minutes	10		
Spinach	do	No. 2	4 minutes in water; 15 minutes in steam.			90	
Squash, winter	do	do	10 to 15 minutes in steam.	120 to 300 minutes			90

[1] In pint jars only, when processing glass jars in water bath.

TABLE 3.—*Time required for blanching and processing fruits and vegetables*—Continued.

Product.	Glass jar.	Tin can.	Blanch or cook.	Water bath at 212° F.	Steam pressure.		
					5 pounds, 228° F.	10 pounds, 240° F.	15 pounds, 250° F.
					Minutes.	*Minutes.*	*Minutes.*
Strawberries	Pint or quart.	No. 2, 2½, or 3.		10 to 20 minutes.	10		
Sweet potatoes	do	No. 2 or 3.	10 to 15 minutes.	180 to 300 minutes.			
Tomatoes	do	No. 2, 2½, or 3.	1 to 1½ minutes.	25 to 30 minutes.	15	10	
Tomato purée.	do	No. 2.	do	do	15	10	
Vegetable mixture (tomato and corn), as specified for canning in each case.	do	do					30
Vegetable-soup mixture, as specified for canning in each case.	do	do				40	

TABLE 4.—*Approximate number of cans or jars per bushel of fruit or vegetables.*

Product (1 bushel).	No. 2 cans or pint jars.	No. 3 cans or quart jars.	Product (1 bushel).	No. 2 cans or pint jars.	No. 3 cans or quart jars.
Windfall apples	30	20	Tomatoes	22–24	15–18
Standard peaches	25	18	Shelled lima beans	50	30
Pears	45	30	String beans	20–30	14–20
Plums	45	30	Sweet corn	30–45	
Blackberries	50	30	Peas in shell	13–18	8–10
Windfall oranges:			Sweet potatoes	30	20
Sliced	22	15			
Whole	35	22			

TABLE 5.—*Steam pressure obtained in pressure canners and corresponding degrees of temperature.*

Pounds of pressure.	Degrees Fahrenheit.	Degrees centigrade.
3	220	104.5
5	228	109
10	240	115.5
15	250	121
20	259	126
25	267	130.5

TABLE 6.—*Boiling point of water at different altitudes above sea level.*

Altitude.	Boiling point.	
Feet.	° *F.*	° *C.*
1,025	210	99
2,063	208	98
3,115	206	97
4,169	204	96
5,225	202	94.4
6,304	200	93
7,381	197	92
8,481	196	91
9,031	195	90.5

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